UiT The Arctic University of Norway

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Training of seafarers working on ships operating in polar waters

How the existing training courses meet the requirements in the Polar Code and increase the safety

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Master's thesis in Technology and Safety in the High North - TEK-3901 - January 2022

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Abstract

The aim of this thesis is to identify the competence gaps for seafarers who sail in polar waters have after completing the existing training courses based on the Polar Code. The best way to protect the environment and people in the Polar regions is by increasing the knowledge and competence of the people working in the vulnerable regions to ensure they make the best possible decisions and avoid dangerous situations. The goal is to identify the gaps in the existing training courses for seafarers and the desired competence level to ensure safe maritime operations in the challenging Polar regions. Researching the current courses provided to comply with the Polar Code will hopefully give insight in how prepared seafarers will be when facing the harsh climate and how to reduce the likelihood of human errors due to inexperienced crew.

The decreased sea ice in the Polar regions opens the waters and the possibility for more ships to operate in polar waters, and the polar cruise tourism has increased drastically. The increased number of ships sailing in these areas presented new challenges regarding safety for both people and the vulnerable environment, which resulted in the Polar Code. The Polar Code entered into force on January 1, 2017, setting requirements for ships operating in the waters around the North and the South pole. The Code is a great addition to other rules and regulations, setting requirements to ships, equipment, pollution, and crew. It should be noted that the safety requirements in the Polar Code do not apply to fishing vessels.

Chapter 12 in the Polar Code sets requirements to competence for personnel working on ships operating in polar waters, resulting in new courses developed to comply with the requirements in the Polar Code. The Basic and Advanced Polar Code courses (IMO Model course 7.11 and 7.12) focus on navigation in polar waters and are made for navigational officers, chief officers, and captains on ships operating in ice-covered waters, excluding those working on a vessel, not in charge of a navigational watch – which may be a large number of the crew. Depending on the ship's size, flag, and operations to be carried out, the number of crew will vary. A cruise ship will have a significantly larger crew than an oil tanker or supply ship because of the number of passengers. To survive in polar waters for up to 5 days (as requested in the Polar Code) will be complex and challenging, even with a small crew. Surviving with a big group of passengers and crew on a typical cruise ship will be more difficult because the passengers do not have the same experience and training as crew trained according to STCW requirements.

Due to more ships operating in polar waters, rules and regulations were needed to ensure the safety of people and the environment. By setting requirements for vessels operating in these waters regarding structural integrity, safety equipment, and crew training, the likelihood of survival if an accident should occur increases. The Polar Code has set requirements making it "harder" to operate in polar waters without proper preparations, equipment, and trained crew.

There are several codes and regulations are set in place to ensure safety by IMO. However, by focusing on STCW, SOLAS, and the Polar Code, hopefully, this approach will identify some of the gaps in the competence required by seafarers working on ships operating in polar waters. The research question is thereby as follows:

> **Are the polar training courses increasing the safety of persons onboard ships operating in polar waters, and are these courses sufficient?**

Abbreviations

Abbreviations	Definition
ASSIST	Arctic Shipborne Sea Ice Standardization tool
GLONASS	Global navigation satellite system
GPS	Global Positioning System
IMO	International Maritime Organization
JRCC	Joint Rescue Coordination Centre
MARPOL	International Convention for the prevention of Pollution from ships
MET	Maritime Education and training
POLARIS	Polar Operational Limit Assessment Risk Indexing System
PPE	Personal Protective equipment
PSC	Polar Ship Certificate
PST	Polar Service Temperature
PWOM	Polar Waters Operational Manual
SAR	Search and Rescue
SARex	Search and rescue exercise
SOLAS	International Convention for the Safety of Life at Sea
STCW	International Convention of Standards of Training, Certification and Watchkeeping for seafarers
UNCLOS	The United Nations Convention on the Law of the Sea

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1 Introduction

The decreased sea ice coverage has opened up for more traffic in remote areas, opening new sea routes for shipping purposes and new destinations for the cruise industry in a fragile and remote environment. The international maritime organization (IMO, 2017a) has developed the Polar Code that covers ships operating in polar waters, ensuring the safety of lives, ships, and the environment. However, the increased activity, increases the number of ships operating and results in an increasing risk of an accident in polar waters. An accident in polar waters can be a disaster due to remoteness, limited SAR resources, and extreme weather conditions. In order to decrease the risk, several mitigation measures are put in place to ensure a safe voyage in polar waters.

The polar waters are challenging with harsh weather conditions, icy waters, and remoteness. Even though the Polar Code has set requirements regarding construction, stability, machinery, communication, safety equipment, training, and manning – operating in polar waters is challenging. As seen in different research projects like SARex (Solberg, et al., 2016), the Code is not perfect and needs more precise requirements/improvement and/or guidelines. An experienced crew on the ships operating in the polar waters is crucial for safety; an experienced crew will be able to handle the challenges faced with in these waters due to training. A crew working on a ship sailing in polar waters faces several challenges that seafarers will not face in other waters. Extreme cold affects the performance of both crew and equipment, and the polar night and the midnight sun is a phenomenon that only occurs inside the polar circles. An experienced crew will have a better understanding of the challenges and how to deal with them.

STCW (IMO, 2017b) sets requirements regarding the training and certification of seafarers regardless of the sailing area; the Polar Code has additional training requirements regarding sailing in polar waters, which were amended in the STCW convention in 2018. All companies have training matrixes with courses needed for the different positions to comply with STCW and the charter´s requirements. Depending on which area the seafarer is working in, there will be different training requirements and, in some cases, different requirements for safety equipment and personal protective equipment (PPE) to comply with regulations. The requirements set in the Polar Code regarding training and manning will increase the knowledge of the seafarers attending the course. However, due to the requirements in the Code, not all seafarers need specific training for operating in polar waters. Therefore, all seafarers are not getting the knowledge to face the challenges before they are in the situation, meaning they miss valuable training. Even though, through the available Polar Code training courses, the participant will learn how to prepare both ship and crew.

Seafarers have different experiences working in the cold climate depending on several factors such as nationality, the ship's main working area, and training/courses. Seafarers from countries with cold climate may naturally be more prepared to face the weather conditions because of their knowledge about the effects of cold temperatures.

The goal should always be to have qualified personnel working on ships to ensure crew, passengers, cargo, ship, and environmental safety. Hopefully, this thesis may shed some light on what the industry can do to increase the quality of training of seafarers working in polar waters.

2 Theoretical background

In this chapter, the theoretical background for the thesis is looked at, the rules and regulations which apply in the area, challenges in polar waters and the existing training are reviewed.

2.1 Polar waters

Polar waters are defined in Resolution A.1024 (26) Guidelines for Ships Operating in Polar Waters (2010) to include Arctic and Antarctic waters. Illustrations of polar waters as defined in the Polar Code are shown in the figures 1 and 2 below.

Figure 1 - Maximum extent of the Polar Code's Arctic waters application (IMO, 2017a, p. 9)

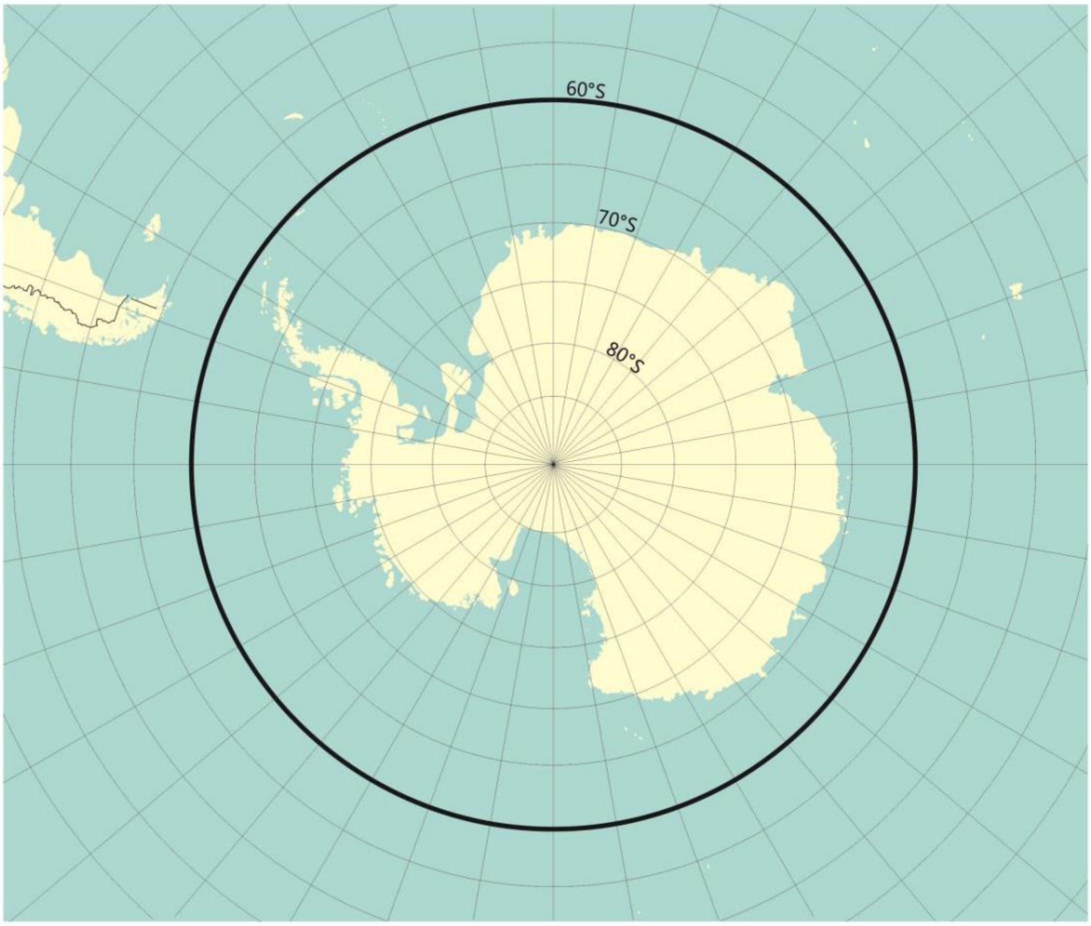


Figure 2 - Maximum extent of the Polar Code's Antarctic area application (IMO, 2017a, p. 8)

According to the Polar Code (2017a), "Ice free waters" means no ice present, "open water" means a large area of freely navigable water with less than 1/10 concentration of sea ice. Ice definitions according to the Polar Code are given in Table 1.

Table 1 - Ice definitions according to the Polar Code (2017a, p. 6)

Type of ice	Definition/Meaning
First year ice	Sea ice of not more than one winter growth developing from young ice with thickness from 0.3 m to 2.0 m.
Thin first-year ice	First-year ice 30cm to 70 cm thick
Medium first-year ice	First year ice of 70 cm to 120 cm thickness.
Sea ice	Any form of ice found at sea which har originated from the freezing of sea water.
Old Ice	Sea ice which has survived at least one summer´s melt; typical thickness up to 3 m or more. It is subdivided into residual first-year ice, second-year ice and multi-year ice.
Ice of land origin	Ice formed on land or in an ice shelf, found floating in water.

2.1.1 Ships operating in polar waters

Hence the opening of the waters, more ships are sailing in polar waters. Shipping activities across the northern polar region are increasing, and the opening of waters is making new shipping routes possible, as seen in Figure 3. Shipping traffic within the Polar Code's geographical area of application in the Arctic has increased substantially during the period between 2013 – 2019 (Engtrø & Sæterdal, 2021). The increased ship traffic in the northern areas has been anticipated, due to the reduction of sea ice and open waters between the Atlantic and the Pacific Ocean during short periods of time.

Figure 3 - Shipping routes in the Arctic region (Humpert & Raspotnik, 2012)

According to Marchenko et al. (2018), different ships operate in arctic waters, and Figure 4, illustrates the types of vessels visiting Arctic ports. As seen in the figure, fishing vessels are a big part of the visits. Passenger ships are also a big part of the visits, mainly in Longyearbyen. Other types of vessels visiting the ports in the area covered by the Polar Code are offshore vessels, cargo ships, bulk ships, chemical tankers, and oil tankers.

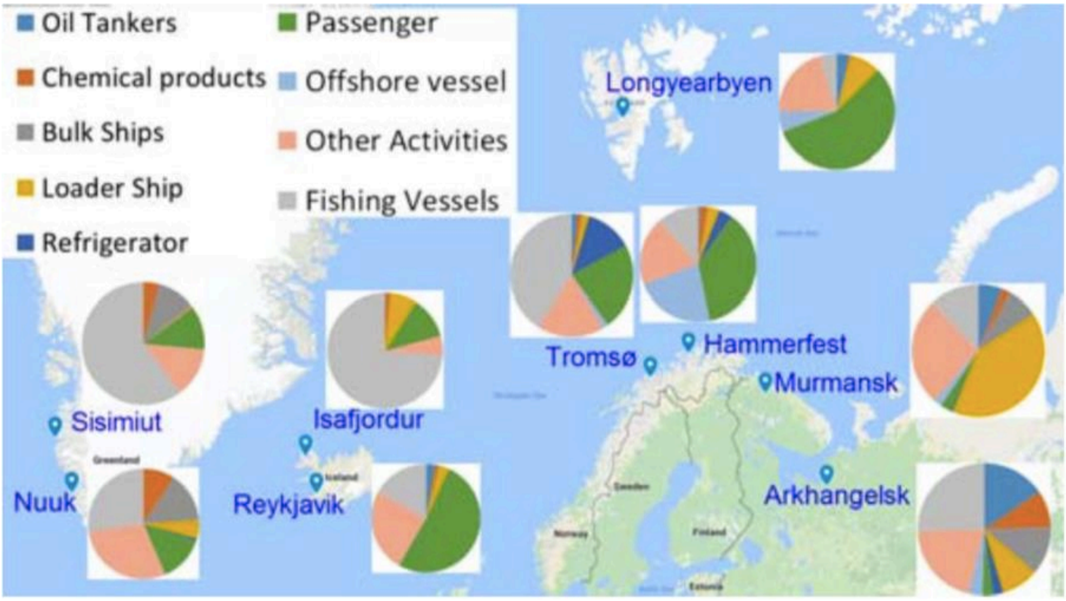


Figure 4 - Type of vessels visiting Arctic Ports, pie charts illustrate the numerical proportion of ships based on type, light grey represents fishing vessels and green represents passenger vessels (Marchenko, et al., 2018, p. 108)

The high population of fishing vessels using the Arctic as their fishing grounds may be the closest to a potential accident happening in the arctic waters. As seen in Figure 5, fishing vessels operate in the waters surrounding Svalbard and in the waters between Greenland and Iceland, and Greenland and Canada.

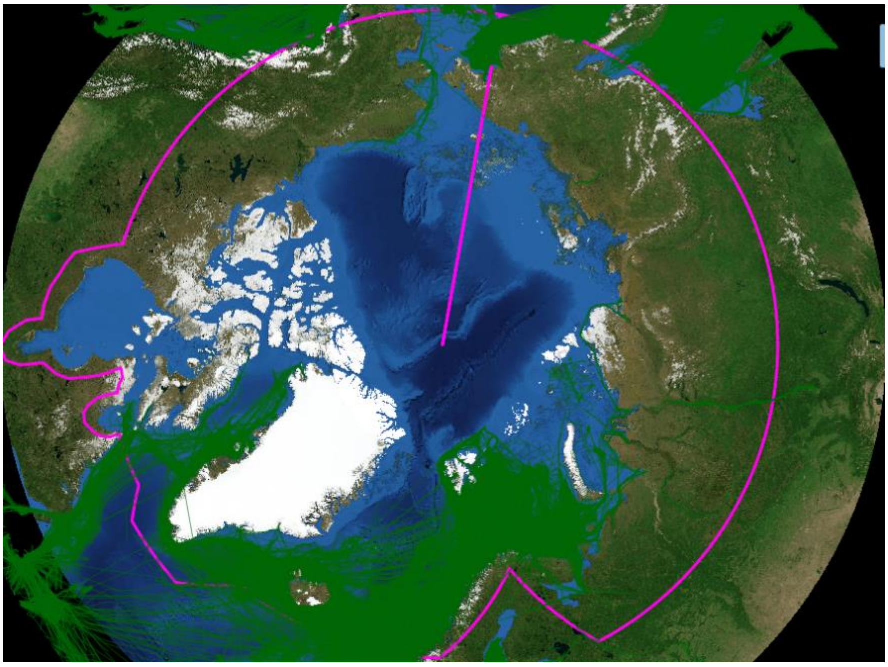


Figure 5 - AIS data of fishing vessels in Arctic waters, green lines are fishing vessels positions (Norwegian Costal Administration, n.d, b)

Figure 6 shows the predefined passing line surrounding Svalbard used to get the data needed to identify how many crossings there were, based on the types of ships, seen in Figure 7 and Figure 8.

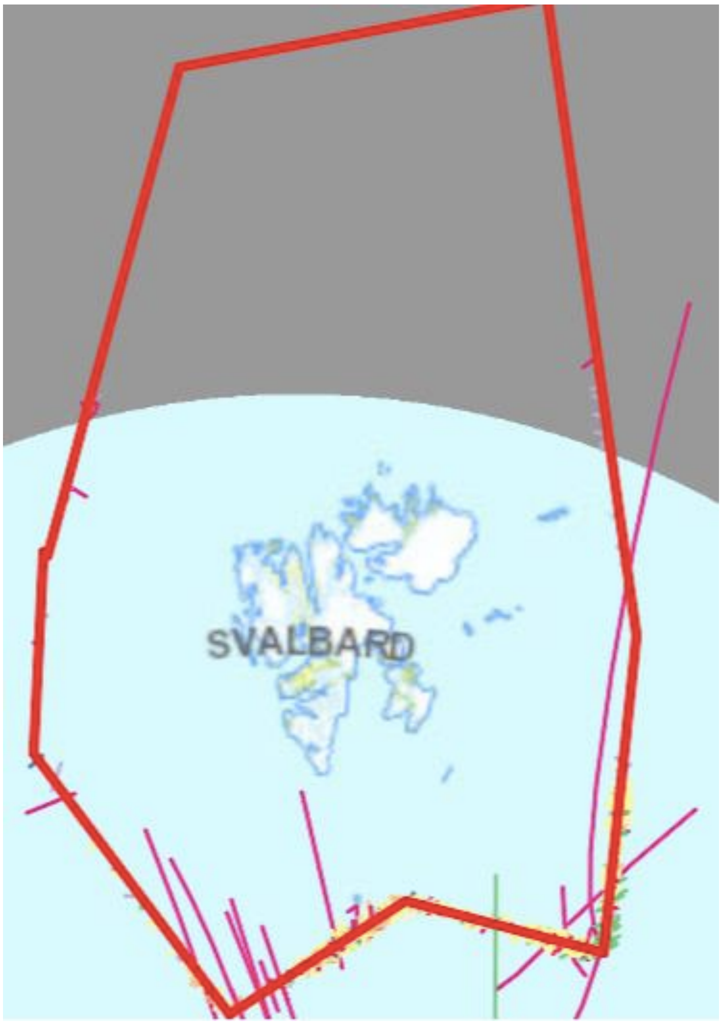


Figure 6 - The user defined passing line surrounding Svalbard used for retrieving AIS data (Norwegian Costal Administration, 2021)

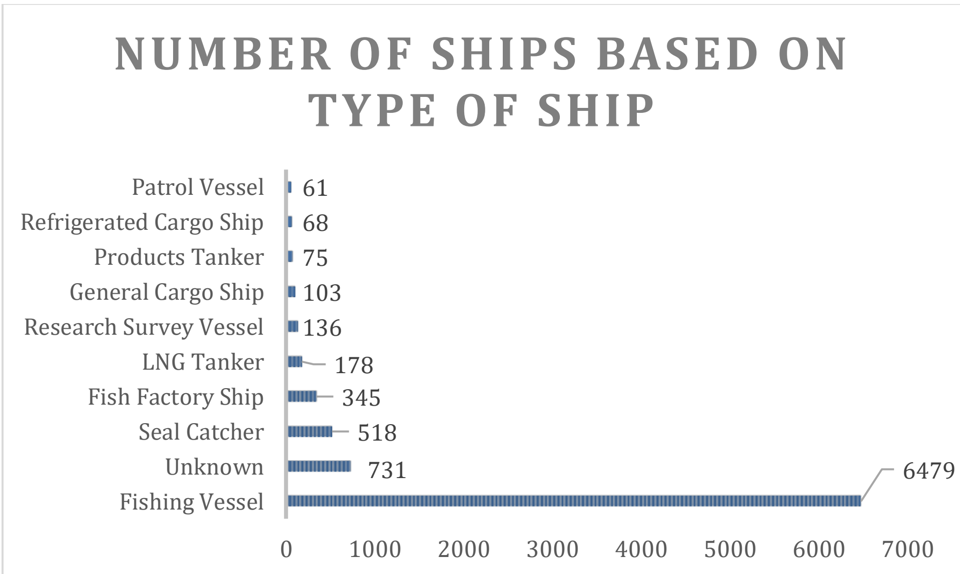


Figure 7 - Number of ships passing the line surrounding Svalbard in 2020 (Norwegian Costal Administration, 2021)

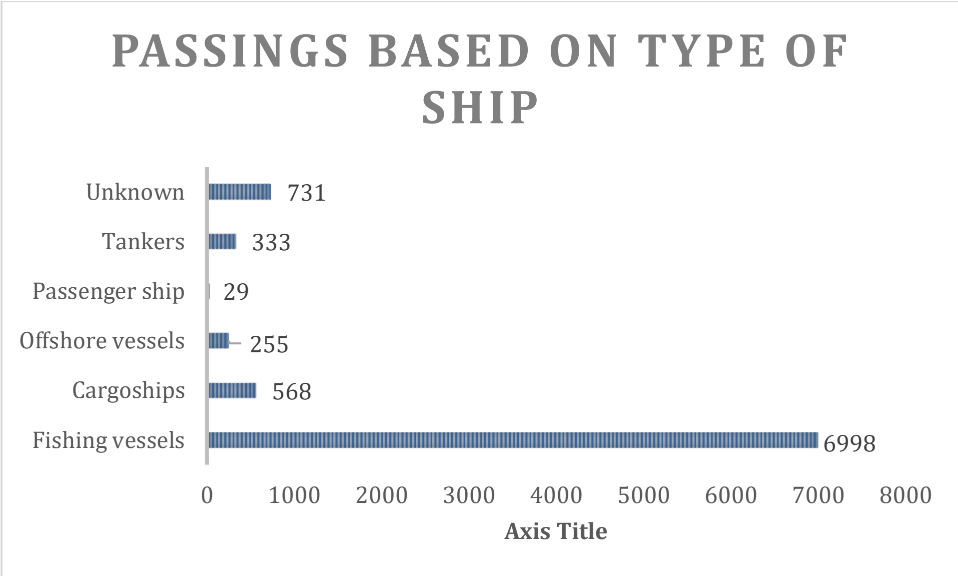


Figure 8 - Passing based on ship type for the line surrounding Svalbard in 2020 (Norwegian Costal Administration, 2021)

The data presented in figures 7 and 8 do not consider that fishing vessels may cross the defined passing lines several times when engaged in fishing. Therefore, by defining a passing line north of Svalbard, as seen in figure 9, might give more accurate data, as shown in figure 10.

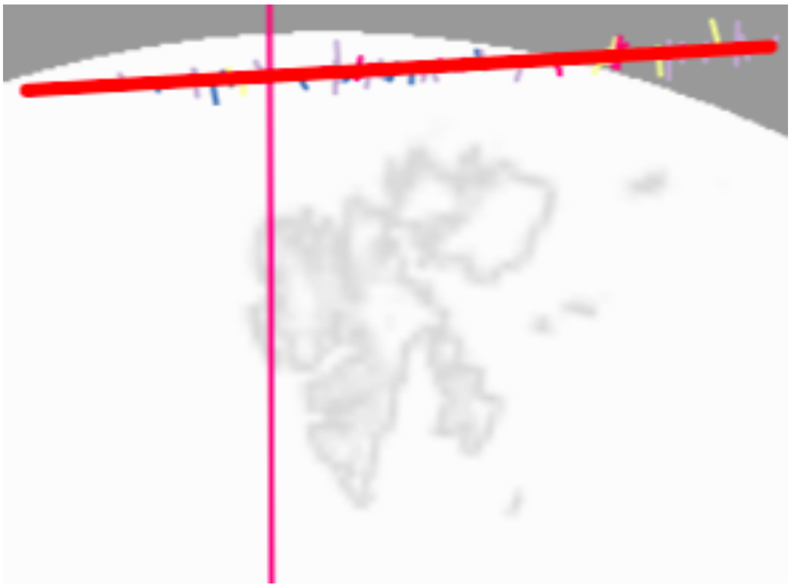


Figure 9 - User defined passing line North of Svalbard (Norwegian Costal Administration, 2021)

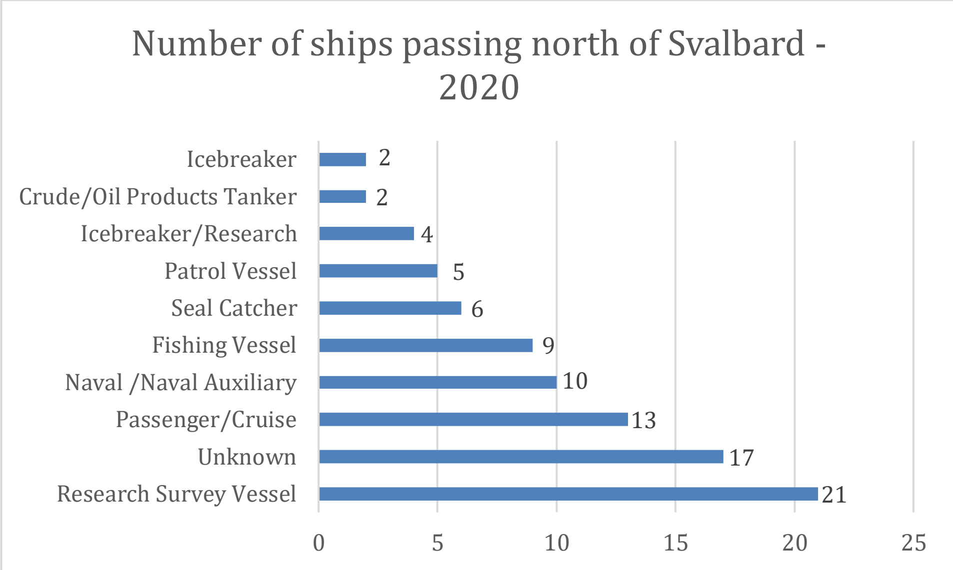


Figure 10 - Ships passing north of Svalbard in 2020, based on ship type (Norwegian Costal Administration, 2021)

As seen in Figure 10, the ships passing the line north of Svalbard most frequent are research survey vessels with 21 passages in 2020. The ships pass the line from June to December, as seen in Figure 11.

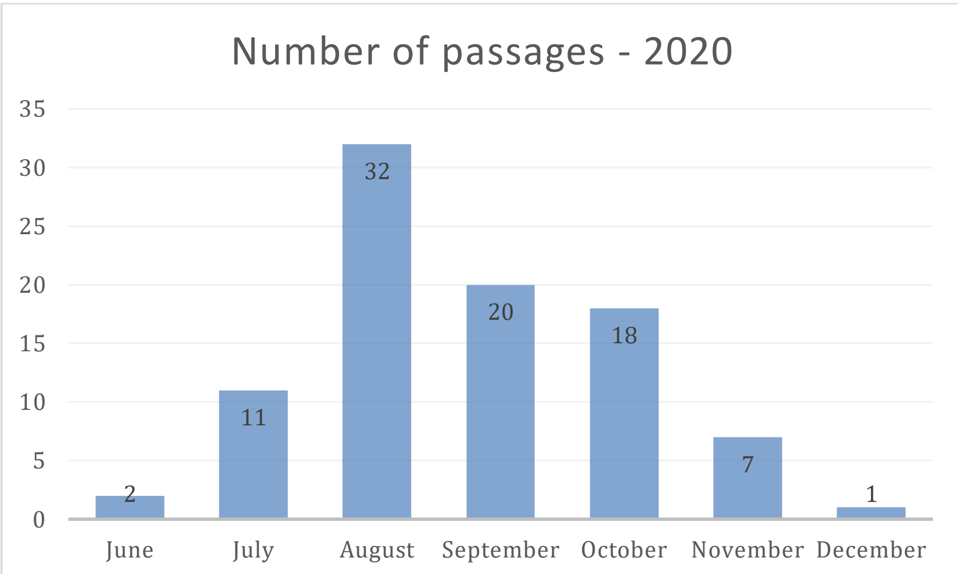


Figure 11 - Number of ships passing the user defined line north of Svalbard in 2020 (Norwegian Costal Administration, 2021)

In the Antarctic waters, there are mostly cruise ships, research ships, and some fishing vessels.
Polar cruise tourism has increased; higher demand means more ships offering cruises in the areas. Tourists want to see the polar regions, the unique climate and wildlife; tourists are willing to pay for it. Therefore, the cruise industry is a growing industry.

Different flag states have ships in polar waters, naturally the "arctic" countries are represented on the list, but also flag states which offers attractive tax and employment regulations are represented on the list. A study done on vessel operations the Arctic waters (Silber & Adams,

2019) states that there are at least two types of activity in the region. Ships from the Arctic Countries such as Norway, Russia and the United States were engaged in extensive commercial fishing, local/regional shipping activities and recourses extraction operations. Commercial vessels registered in countries with little direct interest in the Arctic, such as Panama and Marshall Island. Overall, fishing vessels, primarily <1000 gross tons logged the greatest number of trips and hours of operation during the three years researched, seen in Figure 12.

Country	2015	2016	2017
Panama	754	826	767
Russia	734	763	800
Norway	639	702	727
United States	412	419	410
China, Hong Kong	319	336	334
Liberia	290	288	332
Marshall Islands	267	268	338
Malta	212	216	263
Singapore	210	206	236
Bahamas	189	174	180
Denmark	*	127	126
Iceland	121	111	115
Netherlands	113	105	*
Cyprus	103	119	113

*66 Denmark-registered ships in 2015; 90 Netherlands-registered ships in 2017.

Figure 12 - Nations with >100 flagged vessels operating in Arctic waters and number of registered ships, 2015-2017 (Silber & Adams, 2019, p. 5)

2.1.2 Challenges in polar waters

Navigation in polar waters is challenging; the harsh climate affecting instruments and people in more ways than one, combined with the remoteness, makes safe navigation a complex operation.

Rescuing and assisting ships in distress in polar waters may take time due to the remoteness and lack of infrastructure (Solberg, et al., 2016, p. 4). Therefore, ships operating in polar waters need to be prepared to wait for SAR recourses; the shipowner determines the maximum expected time of rescue for their intended operations, determining the type and amount of survival equipment the ship carries onboard (DNV, n.d, a). In polar waters, there is less activity than along the coastlines, and the distances to the nearest ship may be crucial in an emergency. Joint Rescue Coordination Centre (JRCC) do not have the same resources available in remote areas, such as readily deployable SAR facilities. For example, regarding Svalbard and Norway, rescue operations on Svalbard are more complex due to more considerable distances, fewer ships in the area, and not the same amount of rescue equipment such as available helicopters and personnel – both medical and volunteers. This is a problem, proven by several accidents that have happened in the waters surrounding Svalbard.

The Atlantic sector is divided into five sectors in accordance with the Arctic Council Search and Rescue Agreement (Arctic Council, 2011). These regions have different ship traffic, infrastructure, and terms of nature. Marchenko et al. (2018) conclude in their paper that the increased traffic of oil and gas tankers, passenger ships, and fishing vessels in the Atlantic Arctic may lead to negative incidents with significant consequences. The emergency preparedness resources in the Arctic have been strengthened, but the response time may be high, and capacity may be limited if major accidents occur in Arctic waters.

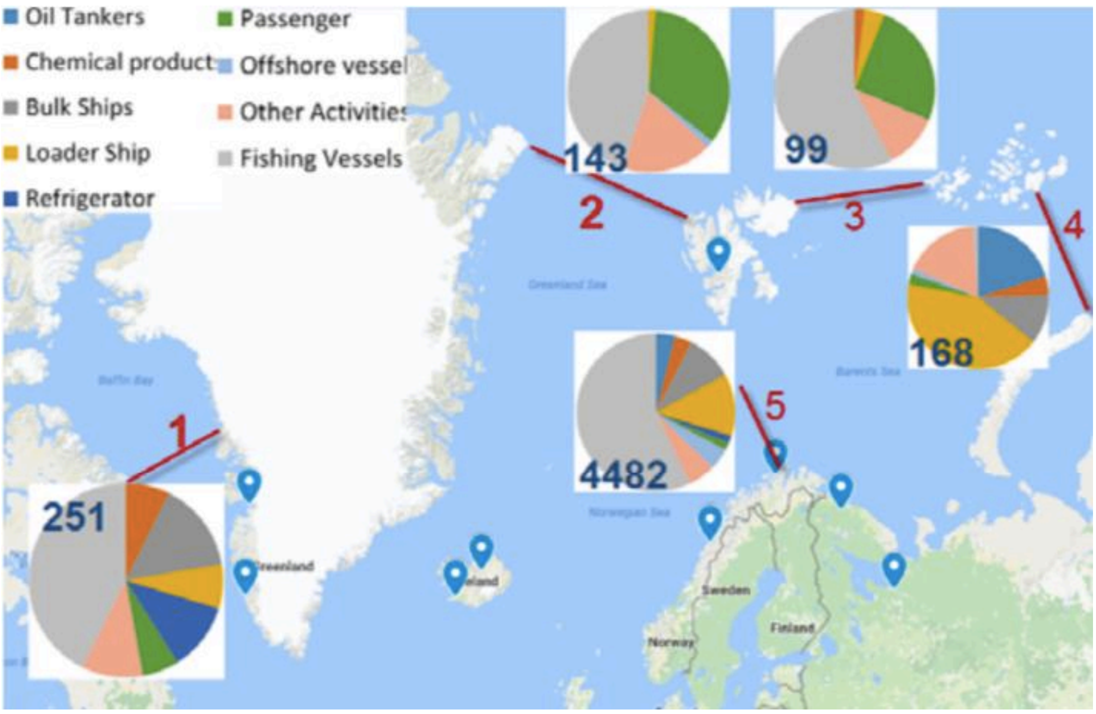


Figure 13 - Types of vessels crossing conventional lines. Blue number is the total number of passengers in one direction. (Marchenko, et al., 2018, p. 109)

2.1.2.1 Cold temperatures

The low temperatures affect the working environment, the performance of humans and equipment, maintenance, survival time, and emergency preparedness. Hypothermia and frostbite may occur for humans exposed to the cold. Windchill is based on the rate of heat loss from exposed skin by wind and cold. Increased wind draws heat from the body and causes the skin temperature to drop. For crew with experience from working in cold climate, the wind chill effect will come naturally.

Low air temperature is in the Polar Code is defined as a Mean Daily Low Temperature colder than -10°C. For ships operating in low air temperature, a Polar Service Temperature (PST) shall be specified and at least 10°C colder than the lowest “Mean Daily Low Temperature” for the intended area of operation and season. The Polar Code contains requirements that systems and equipment shall be fully functional at the PST, including survival systems, which need to be fully operational during the maximum time of rescue (DNV, n.d, a).

2.1.2.2 Icing

When ships operate in sub-freezing conditions and encounter sea spray, rain, fog, or snow freezing, there will be ice on various parts of the ships. Ship icing is a well-known threat for personnel working on ships in cold climate (Samuelsen, 2017). The icing may affect ship stability, and it is essential to keep decks and equipment free of ice, which means that the crew working on the deck needs to remove ice from the ship and critical equipment when working in cold marine climate.

2.1.2.3 Polar night and polar day

The maritime industry is characterized by the necessity of seafarers to work in shifts to keep the vessel going continuously. Various shift lengths are applied on different ships, but commonly used are shifts that break up the day in portions and leave insufficient time for rest and restitution. The work patterns and life onboard vary according to cargo, type of trade, crew, and flag state. In addition, sleeping may be difficult due to vibrations, noise, movements of the ships, and other disturbing factors at sea (Jepsen, et al., 2015). However, in polar waters, the seafarers experience extended periods of darkness during the winter, and daylight during the summer, that may affect navigation and human behavior, health, and wellness (Solberg, et al., 2016). Prolonged periods of daylight or darkness may mess with sleeping patterns and may result in fatigue, affecting the crew's performance and possibly resulting in human error.

2.1.2.4 Charts and Ice Charts

With the changing landscape due to the ice edge moving closer to the poles (Engtrø & Sæterdal, 2021), more waters open up, which are not properly mapped. The lack of accurate and complete hydrographic data and information, including reduced availability of navigational aids and seamarks, increases the risk of grounding. The Norwegian mapping authority is mapping the waters surrounding Svalbard, making sailing in the waters surrounding Svalbard safer. Ships sailing in the area, like "Polarsyssel" the governor of Svalbard´s guard vessel, map the seabed as they sail in non-chartered areas.

Navigational charts supply seafarers with the latest information on depths, aids to navigation, shorelines, and other features required for safe navigation. Nautical charts are based on hydrographic surveys. Canada, Denmark, Norway, the Russian Federation, and the United States have established an "Arctic Regional Hydrographic Commission". The commission promotes cooperation in hydrographic surveying and nautical charting (National Ocean Service, n.d.).

Arcticinfo is a free service provided by the Norwegian Costal Administration, made available for free through Barentswatch (Norwegian Costal Administration, n.d, a). The site is made for the vessels operating in arctic waters. Arcticinfo offers a lot of information based on the users' needs. The service offers ice charts, weather forecasts, and AIS data.

The Norwegian Ice Service is responsible for ice monitoring within the Atlantic sector of the Arctic and provides ice charts emphasizing on Svalbard and the Barents Sea. The ice charts, *Figure* 14, are high-resolution routine products based on a variety of satellite data sources, primarily Synthetic Aperture Radar and optical, and the charts provide sea ice concentration and delineate areas of fast ice, see *Figure* 15 regarding Russian Ice charts. The Norwegian Ice service also provides charts for the Antarctic as part of the "Collaborative Antarctic chart" project between Russia, The United States, and Norway. Data from passive microwave sensors are also analyzed because some areas in the Antarctic lack high-resolution satellite coverage (Norwegian Meteorological Institute, n.d, b).

In addition, Ice Watch is an international, collaborative program that helps coordinate sea ice observations from ships operating in the Arctic. By using the Arctic Shipborne Sea Ice Standardization tool (ASSIST) software developed to help collect and archive data (Norwegian Meteorological Institute, n.d, a).

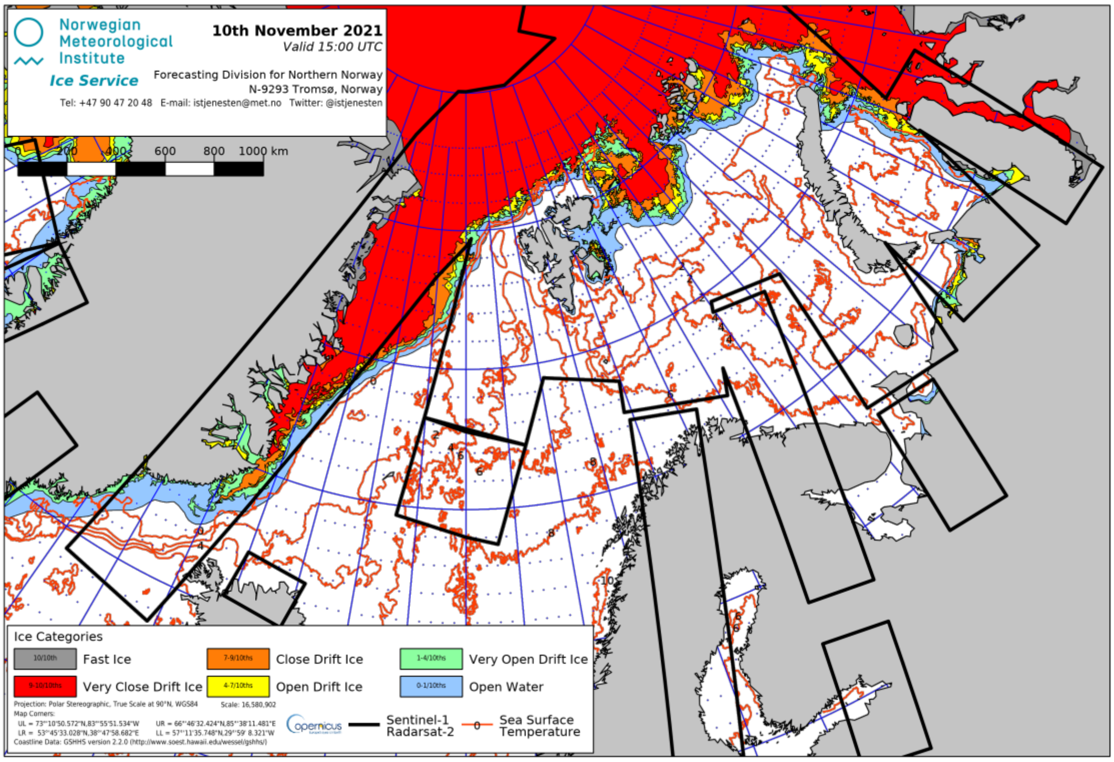


Figure 14 – Example Norwegian Ice chart (Norwegian Meterological Institute)

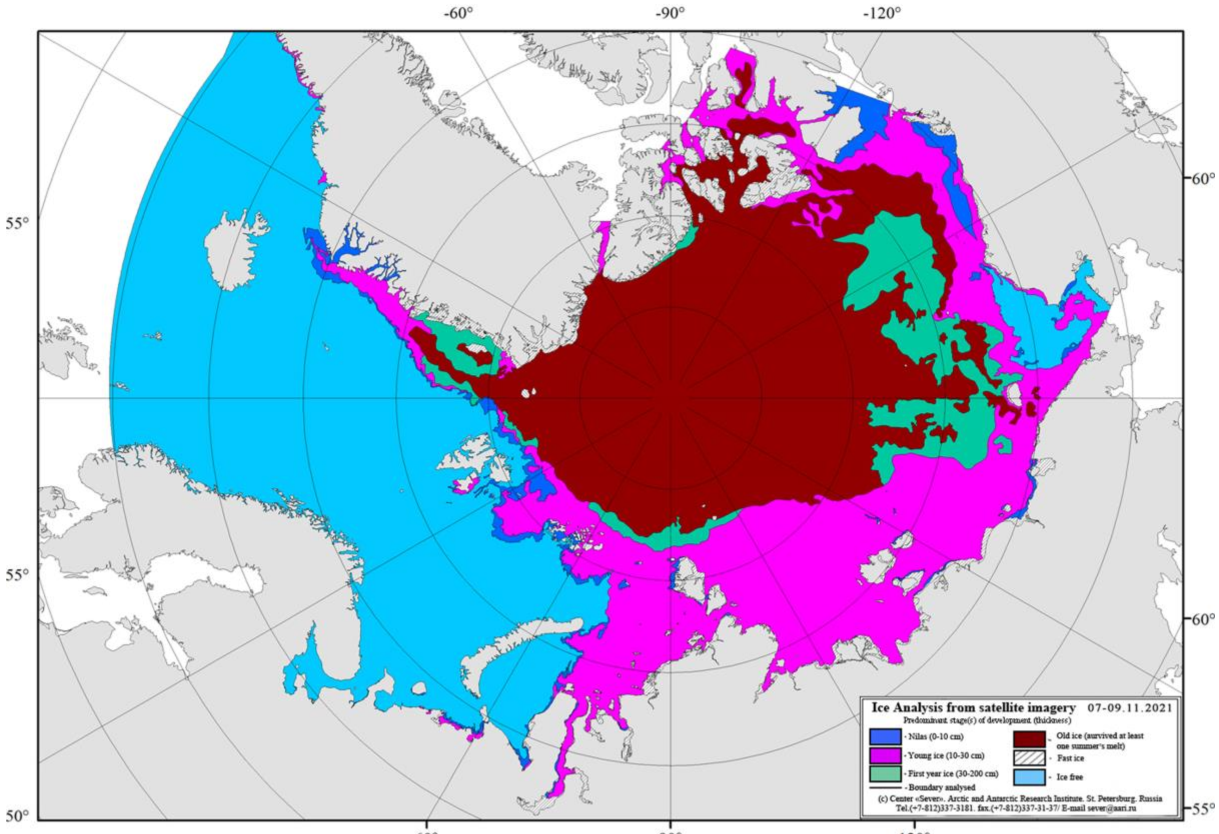


Figure 15 – Example Russian ice chart (The Northern Sea Route Administration)

Since the activity in polar waters has increased, there is an increased need for good and updated ice charts. Researchers are working on a new way to make ice charts fast by using an algorithm that recognizes the different types of ice and open waters (Schneider, 2021). Traditionally, mapping the sea ice is done by visual analysis and interpretation of radar satellite pictures, which is time-consuming and only done by experts. The new way of making ice charts increases safety by determining what types of ice are present, where the ice is, where it is moving, and at what speed. There is still some work that needs to be done before automatically generated ice charts is reliable information. However, it will make it easier to sail and work in remote icy waters in the future.

Ice charts from different providers have different information in them. However, the nomenclature and color code standards follow the World Meteorological Organization Ice Chart Color Code Standard and Sea Ice nomenclature documents. The two-color codes are based on total concentration and stage of development. Patterns symbols are included, along with color and/or egg codes are included in some cases. Ice charts are of great importance, as they make tactical and strategic 24-hour route planning possible.

Some charts provide more information using the egg code, which gives basic data concerning concentration, stages of development, and form of ice in a simple oval form. For example, Canadian ice charts use the egg code (Government of Canada, n.d.), see Figure 16, with some minor additions to the egg symbol, to report additional ice classes, especially during freeze-up and break-up.

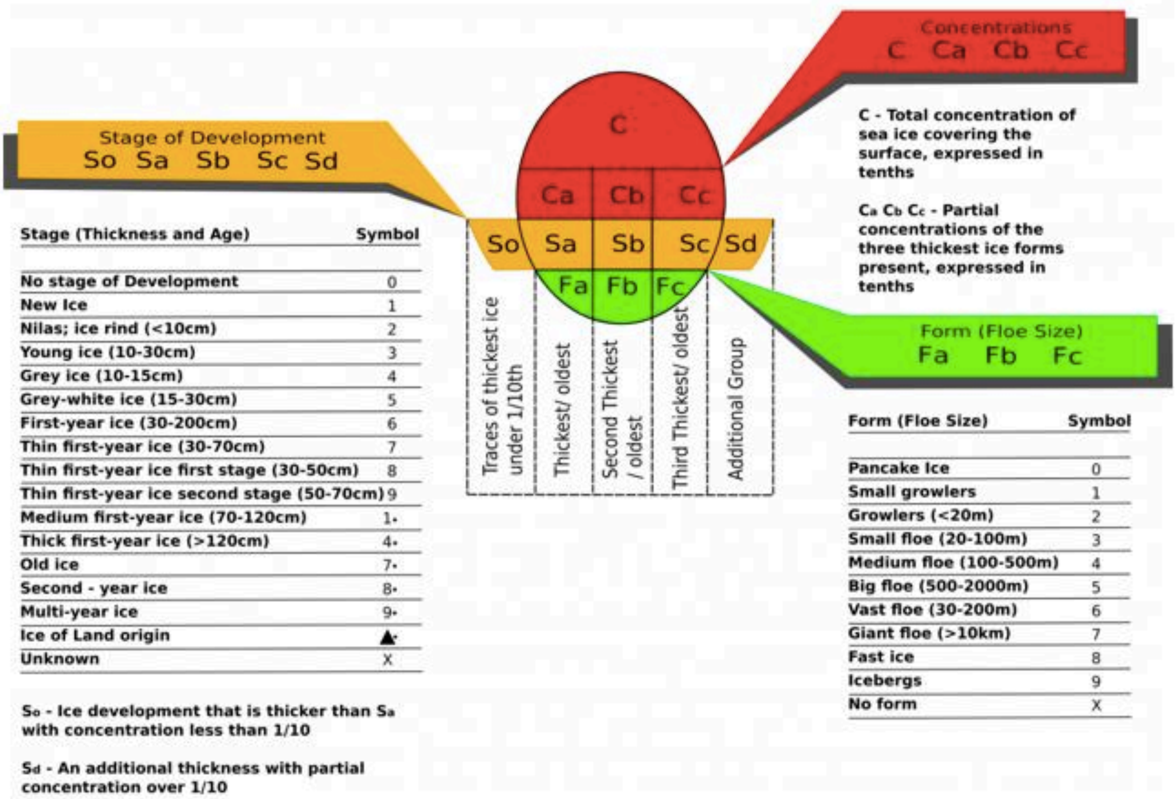


Figure 16 – Explanation of the egg code for ice charts (Norwegian Meteorological Institute, n.d, c)

2.1.2.5 Communication & navigational equipment

The lack of communication stations has previously been problematic during accidents in the high north. One of the latest accidents in the waters surrounding Svalbard was when the fishing vessel Northguider went aground northeast of Svalbard; the Norwegian coastal radio did not get in contact directly with the ship. Luckily, a Norwegian coastguard vessel was in the area and could hear both the fishing vessel and the coastal radio and worked as a relay station providing the crew on Northguider with the information given by the cost radio station (Rommetveit & Nøkling, 2019). Due to the increased number of ships sailing to the high north, the government of Norway has funded Telenor to install HF transmitters on Svalbard and in Hammerfest to ensure critical emergency communication in the polar waters surrounding mainland Norway and Svalbard (Telenor, 2021).

The performance and availability of standard navigation and communication systems may be limited when operating in high latitudes. Both magnetic and gyrocompasses may become unstable in high latitudes. The magnetic variations may lead to unreliable readings on magnetic compasses, and gyrocompasses may become unstable and may need to be shut down (IMO, 2010, p. 25). In addition, speed and distance measurement sensors need to be protected from damage by ice. A satellite system should be fitted for ships navigating outside of reliable coverage of a terrestrial hyperbolic system. Therefore, the Polar code requires additional communications and navigation equipment for vessels operating in high latitudes.

Positioning in the Arctic is challenging since the global positioning system (GPS), and global navigation satellite system (GLONASS) are not as accurate in the Arctic as in non-Arctic areas due to the low number of visible satellites, severe ionospheric disturbances, and higher delays (Yastrebova, et al., 2021). There are four different global satellite positioning systems, each of which can be used at high latitudes. However, according to Januszewski (2016) the geometry and visibility of satellites are the best in the case of GLONASS system.

Iridium is a global satellite communication system using low earth orbit satellites. The Iridium system makes it possible to communicate even if located on a ship or at the poles as the only satellite provider capable of offering voice and data services anywhere on earth (Iridium, n.d.). In addition, the iridium system provides global coverage, including the polar areas, but at a limited data rate (Solberg & Gudmestad, 2018, p. 72). According to Iridium, this makes Iridium the preferable communications provider because they deliver reliable, weather-resilient connectivity to the entire planet, including the poles.

2.1.3 The maritime industry

The maritime industry needs to comply with the regulations set by IMO, which makes sure that companies cannot cut corners regarding safety to reduce costs. Which codes and regulations apply depends on the ship's size, operation, operation area and what it is carrying.

Shipping companies need to follow the rules and regulations but can also set qualification requirements for their crew. The minimum requirements according to STCW (IMO, 2017b) must be met, but the shipping companies may have additional requirements. For example, when hiring personnel, they set qualification requirements such as required courses, and certificates, personal characteristics, and experience from similar operations. The companies are required to ensure satisfactory training regardless of vessel type, and all persons working on board shall receive necessary training to be able to carry out their work in a safe and proper manner according with the Regulations on working environment, health, and safety on board ships (Norwegian Maritime Authority, 2005).

Personnel working on ships carrying passengers designated on the muster list to assist passengers need "Crowd and crisis management"; A course that provides training on how crew should behave in the event of a crisis onboard and how to act and communicate with passengers. This course should prepare the crew to control and communicate effectively with a crowd during an emergency onboard.

Different class societies offer to assist shipowners in making the ships polar operating profile. The ship's operating profile and the conclusion from the operational assessment determine which parts of the Polar Code apply to their vessels. The shipowners need, based on that, to determine the type and amount of survival equipment needed on board, based on the maximum time of rescue. Some requirements in the Polar Code must be met by design measures and some by operational procedures, and in some cases, the owners may choose the design or operational measures to comply with the code. The polar code relies on ship owners and operators to develop processes that adequately address ship operations (DNV, n.d, a).

Vessels engaged in fishing are frequently operating the arctic waters surrounding Svalbard. Since fishing vessels are a big part of the population of ships in this area, there is an increased probability that a fishing vessel may be the closest assistance available in an emergency situation in these waters. Fishing vessels vary in size and, therefore, the number of persons on board. Compared to the types of passenger ships operating in the Arctic waters, they may be significantly smaller than a cruise or expedition ship. Most fishing vessels are not subject to the Polar Code due to the length of the fishing vessels operating in the area. However, the Norwegian Maritime Authority has published recommendations for ship operation in polar waters for vessels not carrying a Polar ship certificate (Norwegian Maritime Authority, 2020). These recommendations include the matters to be considered by the company and crew before departure. Such as risk-minimizing, vessel fitness, environment, the competence of crew regarding procedures and risks, weather information, quality of maps, suitable equipment, and maintenance. The Polar Code will serve as guidelines in the developing procedures and emergency preparedness plans for ships without a Polar Ship certificate before operating in polar waters.

2.1.3.1 Insurance companies

In order for a company to manage the negative consequences of an accident, it can either take all the consequences if/when an accident occurs, or reduce the probability for an accident and/or its consequences, or transfer the consequences to parties better able to handle them (by buying insurance from insurance companies) (Trantzas, et al., 2018). There are different types of insurance the shipowners should have on their ships; some examples are crew cover, hull and machinery, protection and indemnity (P&I), and total loss.

The opening of new sea routes may potentially save much money for shipping companies because of the shorter travel time. The problem is that the polar waters are new territory, without known risks and tested shipping routes compared to the rest of the world (Saul, 2020).

When insurance companies assess risk for insurance coverage, historical loss data is a key factor. However, there is limited information due to the limited number of sailings and trade routes opening due to the changing ice conditions. Therefore, insurers are likely to take a cautious approach when assessing the risk of sailing in Arctic waters. The Polar Ship Certificate (PSC) will be a crucial factor in the risk assessment since the PSC will categorize the vessel in accordance with its design and ability to operate in certain polar conditions as provided in the Polar Waters Operational Manual (PWOM). Some of the factor's insurers consider according to The International Union of Marine Insurance (IUMI, 2018), and question from a marine insurer's perspective are:

- Vessels:
    - For existing vessels built before 2017:
        - Ice damage residual stability
        - Escape routes arrangement
        - Navigation equipment redundancy
        - Enclosed bridge wings on ice classed vessels
        - Oil tank separation distance from side shell
    - Low temperature operations
    - Stability characteristics in ice conditions
    - Navigation in ice conditions
- Infrastructure:
    - Towage/rescue (Limited rescue capacity, capacity along the route, how the vessel will cope if rescue takes weeks)

  - Place of refuge
  - Spare parts
  - Salvage
  - Repairs (Lack of available repair yards with depths and quays suitable for the vessel)
  - Ice breakers
- Ice, weather & oceanography
  - Ice (Unpredictable and changing ice conditions and risk of icing,)
  - Weather (Reduced visibility due to heavy fog and unpredictable weather with heavy storms occurring at any time)
  - Oceanography (Modern charts and hydrographic surveys may be inaccurate and limited in number)
- Human factor
  - Manning requirement (Experience and training of crew, the effect of extended periods of daylight and low temperature on crew)
  - Language skills during transits
  - Prior experience in the Arctic of the owner/operator
  - Safety culture of owner/operator
- Other example factors:
  - Bunkering arrangements
  - Class

With the increased probability and the potentially severe consequences of even minor incidents occurring in the polar environment, insurance will only be available on a case-by-case basis -if at all in certain defined areas (IUMI, 2018).

The most common problem in the Arctic water has been equipment that freezes and gets stuck. The claim for the physical damage may be small, but the insurer's cost for getting a damaged ship back to ports from remote locations may be very high (Saul, 2020).

2.1.4 Training of seafarers

Emergencies may be encountered in every industry, but in the maritime industry, emergency preparedness is crucial due to remoteness, the need to be self-sufficient, and harsh weather conditions which may prevent external help (Vinnem, 2011). Personnel working on ships need to be prepared to face emergencies. It is required to have established strict procedures including drills and exercise programs. Focusing on safety and establishing a good safety culture among crew and shipping companies to make everyone knowing their tasks and responsibilities in an emergency. To prepare the crew for emergencies, they have to go through safety training onshore, and there shall be regularly drills onboard. According to

SOLAS (IMO, n.d, a), some drills are mandatory, such as a monthly firefighting drill. Shipping companies provide ships with company standard training matrixes made for the specific type of ship.

Fire, contact/collision, explosion, flooding, grounding, machinery failure, loss of hull integrity, and handling equipment failure are common accidents in the shipping industry. The same type of accidents may happen in the Arctic, but the risk of collision with other ships is lower than in an area with much traffic. However, the risk of making contact with ice is present, and old maps of a changing landscape due to reduction in ice cover and due to glaciers' retractions, increase the risk of grounding (Sollid, et al., 2018). Seafarers conduct drills in order to train on what to do in case of collision, flooding, fire, grounding, and other types of emergencies. The drills are essential to make the crew familiar with their tasks, where to meet, where to find equipment and how to react in case of emergency. Drills may be postponed on board, however, due to work overload, time limitation, or lack of safety awareness.

The human factor plays a critical role and may lead to fatal accidents. A ship´s crew is expected to complete operations and procedures such as emergency response without errors. An effective response to an emergency is essential, but both physical and mental fatigue cause a decrease in alertness, mental concentration, and motivation (Akhtara & Utne, 2014). Therefore, fatigue may negatively affect the emergency response in an emergency onboard a ship (Tac, et al., 2020).

After the SARex3 exercise (Solberg & Gudmestad, 2018), captain A. Kjøl wrote a chapter in the SARex3 report about the captain's role in ensuring SAR recourses among staff. This chapter states that ensuring reliable SAR recourses could be challenging for the master onboard due to different individual responses to a chaotic evacuation and survival phase. In addition, the remoteness, longer time for rescue, and the harsh environment will increase the severity and magnitude. Therefore, creating a drill scenario on board to the extent that the master can identify the best leaders to handle a crisis will be challenging.

In order to survive the maximum time of rescue, a combination of technical and individual skills will be successful parameters for prolonged survival, Figure 17. The master often does not influence in hiring seafarers, and there are no additional training requirements for survival craft commanders. Onboard ships, often the same onboard position is responsible for a certain lifeboat or raft, regardless of personal skills, special training, or experience of survival situations. This may not be a big issue for ships with a limited number of crew and few survival crafts. It is most likely that the persons with the strongest leadership skills will lead best in the situation and assist the master, regardless of onboard position. On larger passenger ships, ensuring good leadership and integrity in each survival craft can be difficult for the master.

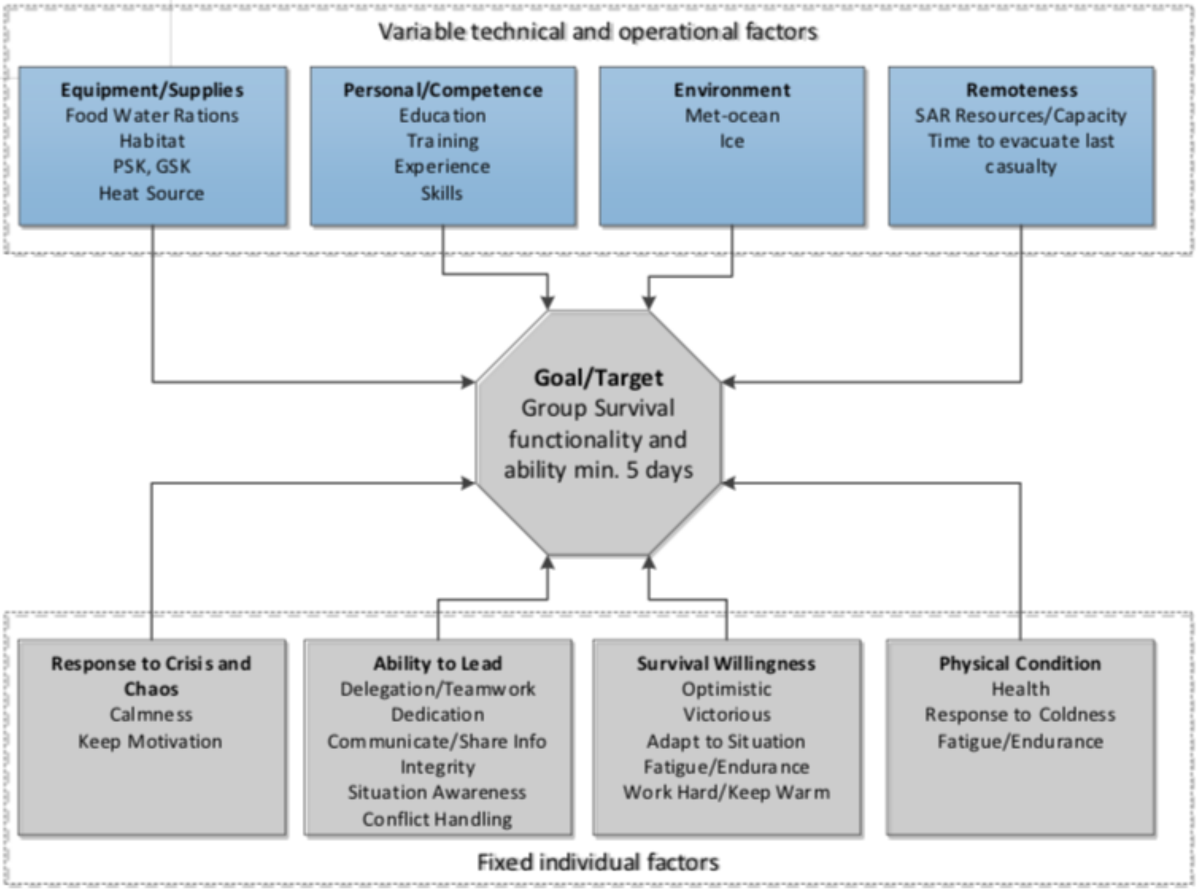


Figure 17 - Factors for survival (Solberg & Gudmestad, 2018, p. 162)

2.1.5 Human error

Different factors are responsible for the cause of accidents, such as weather, route selection, training of personnel, use of equipment, specification of the vessel and human factors. In the maritime industry the accidents caused by human error is high, even though the technology has improved significantly.

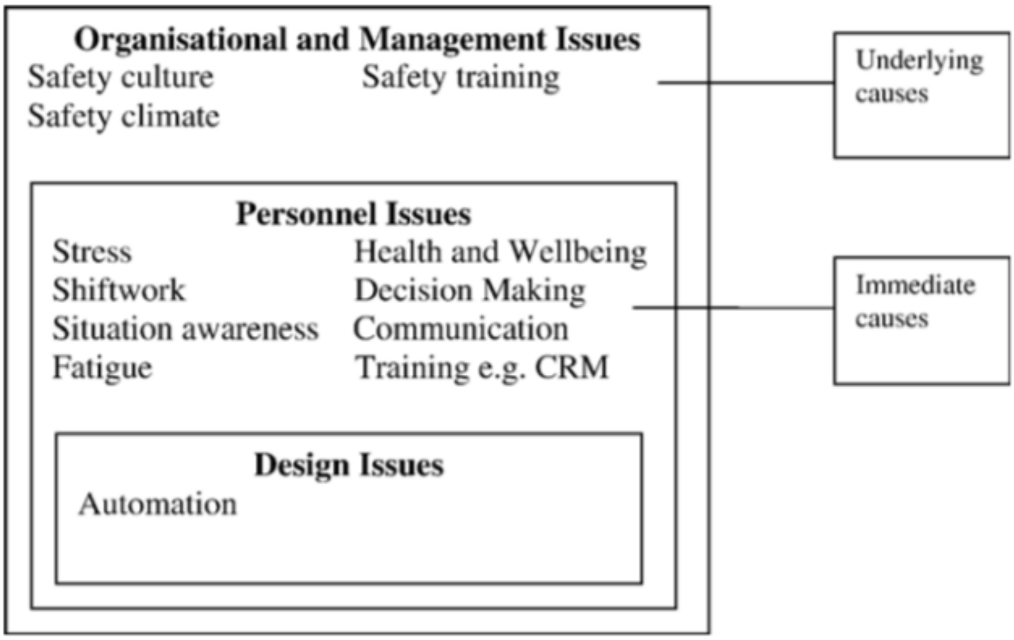


Figure 18 - Organized framework for human factors contributing to organizational accidents in shipping (Hetherington, et al., 2006),

As seen in Figure 18 above, design issues, personal issues, and organizational and management issues are human factors that may lead to errors. Personal issues are categorized as immediate causes to marine accidents.
Humans are affected by the environment and climate as well as the ship and equipment. Fatigue, complacency, inadequate general technical knowledge, decision-making based on poor, inadequate information, and poor judgment and equipment design are some factors that lead to human error.

2.1.5.1 Personal issues

Elevated stress levels for an extended period will lead to negative mental and physical health outcomes. In a study done regarding stress levels for seafarers, 60% of all crew reported moderate to high stress levels (Hetherington, et al., 2006). All seafarers must have an approved health certificate, but the working environment affects the seafarer. Long working hours and lack of sleep can cause fatigue making seafarers not prepared to do their job satisfactorily. Human error such as miscommunication can lead to accidents. Lack of experienced crew operating in ice infested waters may increase the risk of human errors (Solberg, et al., 2016). The IMO Basic model course 7.11 (CMS, 2016a) has included "Fatigue problems due to noise and vibrations during ice transit" and "Working in cold environments may increase crew fatigue" as a part of the detailed learning objectives under the competence theme "Apply safe working practices, respond to emergencies".

Situational awareness is the ability to process a mental model of what is going on at any one time and to make projections as to how the situation will develop. Situation awareness is a contribution to several human errors on ships.

Communication is important for effective and safe performance in several industries, and it affects the team situation awareness, team working and effective decision making. Inadequate communication or language problems may result in misunderstandings which can be a contributing factor to an accident (Hetherington, et al., 2006).

2.1.5.2 Organizational issues

Safety culture, training and climate is organizational issues that may lead to human error. Crew resource management is training on non-technical skills to best practice, it is defined as cognitive and social skills: teamwork, communication, situation awareness and workload management. Enhanced CRM training may result in reduced incidents caused by human factor. In the maritime industry Bridge Resource Management is the CRM for officers working on the bridge.

Working condition, workload, management/employee commitment to safety, safety norms, reporting culture, safety behavior and safety communications are some factors contributing to the safety climate in the maritime industry.

2.2 Rules and Regulations

IMO – The International Maritime Organization is a specialized agency with responsibility for safety and security of shipping and the prevention of pollution by ships. IMO is the global standard-setting authority for safety, security, and environmental performance of international shipping (IMO, n.d, b). IMO creates the regulatory framework for the industry. This results in an international standard for all ships, making it impossible to cut corners regarding safety.

The International Convention for the Safety of life at Sea (SOLAS), the International Convention on Standards of Training, Certification and Watchkeeping (STCW), the International Convention for the prevention of Pollution from ships (MARPOL) and United Nations Convention on the Law of the Sea (UNCLOS) are the conventions focused on in this thesis.

2.2.1 International Convention for the Safety of Life at Sea (SOLAS)

The SOLAS Convention is regarded as the most important of all the international treaties concerning the safety of merchant ships (IMO, n.d, a). The main objective of the Convention is to specify minimum standards for the construction, equipment, and operation of ships compatible with their safety. The respective flag states are responsible for ensuring that ships under their flag comply with the SOLAS requirements.

Chapter V – Safety of navigation identifies certain navigation services which the Governments should provide. In contrast to the whole Convention, which only applies to certain classes of ship, this chapter sets forth provisions of an operational nature applicable in general to all ships on all voyages (IMO, n.d, a).

As a main rule, SOLAS applies to passenger ships and cargo ships of 500 gross tonnage and upwards engaged in international voyages. MARPOL has rules that apply to all ships. Part I-A of the Polar Code and chapter XIV of SOLAS are set up as additional requirements for the ships carrying a SOLAS certificate and operating in polar waters. Meaning, the rules will only apply to ships required to hold international safety certificates according with SOLAS chapter I, and therefore not fishing vessels operating in polar waters (Norwegian Maritime Authority, 2016).

2.2.2 International Convention on Standards of Training, Certification and Watchkeeping for seafarers (STCW)

Chapter VI in STCW includes the standards regarding emergency, occupational safety, security, medical care, and survival functions. In section A-VI/1, the mandatory minimum requirements for safety familiarization, basic training, and instructions for seafarers are listed. Regarding safety familiarization training, the STCW code (IMO, 2017b) states that before being assigned duties onboard, all persons employed or engaged on a seagoing ship, other than passengers, shall receive approved training in personal survival techniques or sufficient information and instruction. It also states that employed seafarers in any capacity onboard shall before being assigned shipboard duties receive appropriate approved basic training in: Personal survival techniques (Table A-VI/1-1), fire prevention and firefighting (Table A-VI/1-2), elementary first aid (Table A-VI/3-1), personal safety and social responsibilities (Table A-VI/1-4) (IMO, 2017b).

Seafarers working as officers onboard need advanced safety training, which includes table A-VI/2-1 specification on minimum standard of competence in survival craft and rescue boats, see Appendix II. However, this table is not included in the basic safety training course, so those required to take charge of a survival craft, which is not officers need to complete another course which includes table A-VI/2-1, often called "STCW Proficiency in Survival Craft and rescue boats".

STCW Code Section A-V/4 Polar Code was issued in July 2018 as an amendment to the STCW code. It includes the mandatory minimum requirements for training and qualifications of masters and deck officers on a ship operating in polar waters. The section set a standard of competence with requirements for masters and mates in accordance with table A-V/4-1 and table A-V/4-2 regarding basic and advanced training. STCW Section B-V/4, chapter V is guidance regarding the training of masters and officers for ships operating in polar waters.

2.2.3 UNCLOS

The United Nations Convention on the Law of the Sea is an international agreement that establishes a legal framework for all oceans and their recourses. Covering all seas and all maritime activities, this is an important convention. Regarding polar waters, several nations have land in polar waters, and according to article 193 in UNCLOS says that "*States have the sovereign right to exploit their natural resources pursuant to their environmental policies and in accordance with their duty to protect and preserve the marine environment*." (United Nations, 1982, p. 100)

Section 8 in UNCLOS covers Ice-covered areas. Article 234 states

> " *Costal states have the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of the marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where particularly severe climatic conditions and the presence of ice covering such areas for the most of the year create obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance. Such laws and regulations shall have due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence."* (United Nations, 1982, pp. 115 - 116)

Norwegian authorities banned heavy fuel oil in protected areas surrounding Svalbard in 2014 (Forskrift om nasjonalparkene og naturreservatene på Svalbard, 2014) to prevent heavy fuel oil spills and limit pollution from shipping accidents in remote and exposed areas. 1st of January 2022, a new law prohibits heavy fuel oils in the territorial waters surrounding Svalbard, meaning that fuel with higher viscosity, density and pour point than marine gasoil is banned (Svalbardmiljøloven, 2001).

2.2.4 International Code for ships operating in Polar Waters (Polar Code)

Due to the increased activity around the poles, rules and regulations covering the ships working in these areas were essential and needed. The code sets requirements for the ships and crew operating in the vulnerable area, making it harder to cut corners regarding safety. Since the code is functional and goal-based, it applies to ships differently depending on construction and intended operations in polar waters. The arctic and Antarctic climate demands more of the equipment and personnel, making the code's minimum standards important. The requirements for safety equipment state that it shall be possible to survive up to 5 days. Studies and reports on survival in polar waters show that the basic survival equipment is insufficient to survive as the polar code requires.

The Polar Code does not cover all ships operating in these areas but applies to ships depending on their international certification requirements. The Polar Code is mandatory under SOLAS and MARPOL. Part I – the safety part of the code applies to ships certified per SOLAS and operate in polar waters. Part II – pollution prevention applies to ships that must comply with MARPOL and operates in polar waters. Non-SOLAS ships that hold a MARPOL certificate, only part II – the environmental protection requirements of the Polar Code apply (DNV, n.d, b). This excludes a big part of the types of vessels operating in the area but covers the most important regarding accidents when focusing on human lives and the environment.
The activity in the area has increased, but the requirements increase the safety. In addition, due to decreased extent of sea ice resulting in the opening of waters, new routes are opening up to commercial shipping.

The goal of the Polar Code is to provide safe ship operations, Figure 19, and protect the polar environment by addressing risks present in polar waters and not adequately mitigated by other codes and regulations by the International Maritime Organization.

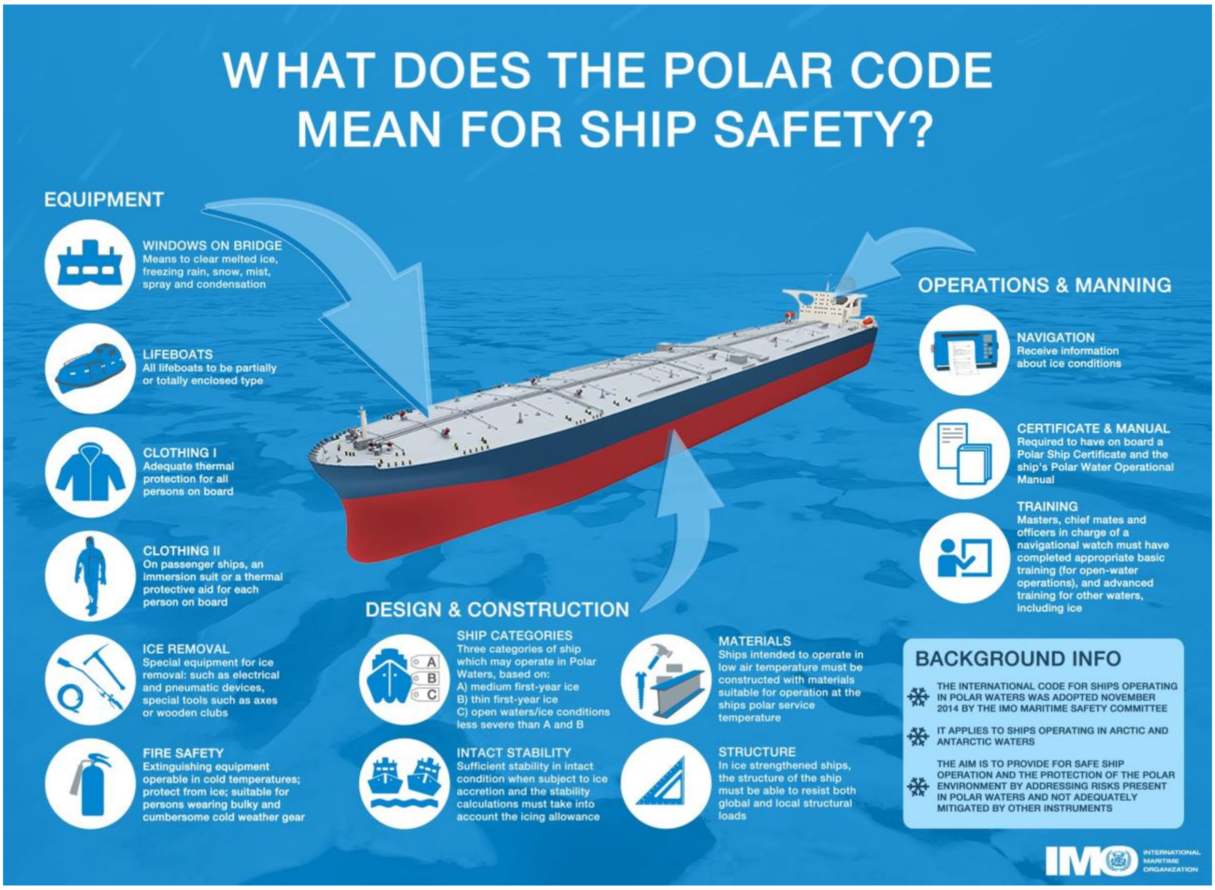


Figure 19 – Infographic of meaning of the Polar Code regarding ship safety (IMO, 2017c)

Table 2 – Ship categories according to the Polar Code (IMO, 2017a)

Category	Definition

Category A	Ship designed for operation in polar waters in at least medium first-year ice, which may include old ice inclusions
Category B	Ship not included in category A, designed for operation in polar waters in at least thin first-year ice, which may include old ice inclusions
Category C	Ship designed to operate in open water or in ice conditions less severe than those included in categories A and B.

Chapter 12 is about manning and training; the goal is to ensure that the personnel working on ships operating in polar waters are appropriately manned by qualified, trained, and experienced people. To meet the functional requirements in chapter 12, masters, chief mates, and officers in charge of a navigational watch need to be qualified according to chapter V in the STCW convention and code, seen in Table 3 and Table 4.

Table 3 - Qualification requirements "Open Waters" according to the Polar Code (2017a, p. 27)

Ice conditions	Tankers	Passenger ships	Other
Ice Free	Not applicable	Not applicable	Not applicable
Open waters	Basic training for masters, chief mate and officers in charge of a navigational watch	Basic training for masters, chief mate and officers in charge of a navigational watch	Not applicable

Table 4 - Qualification requirements "Other waters" according to the Polar Code (2017a, p. 28)

Ice conditions	Tankers	Passenger ships	Other
Ice Free	Not applicable	Not applicable	Not applicable
Other waters	Advanced training for master and chief mate. Basic training for officers in charge of a navigational watch.	Advanced training for master and chief mate. Basic training for officers in charge of a navigational watch.	Advanced training for master and chief mate. Basic training for officers in charge of a navigational watch.

2.2.4.1 Regulatory requirements

In order to comply with the Polar Code, both the ship and the crew must be certified for operations in polar waters. In addition, the ship must be operated within the Polar Ship Certificate's limitations and follow in the Polar Code's operational requirements (DNV, n.d, a).

A polar ship certificate will classify the vessel as a category A, B, or C ship, as defined in Table 2. The issuance of a PSC requires an assessment of the vessel, considering the anticipated range of operating conditions and hazards that may be encountered in polar waters. The assessment will identify operational limitations, plans or procedures, or additional safety equipment needed to mitigate potential incidents (IMO, 2017c). Ships also need to carry a Polar Waters Operational Manual (PWOM); the PWOM will provide the owner, operator, master, and crew with information regarding the operational capabilities and limitations of the ship in order to support the decision-making (IMO, 2017c).

The shipowner and operator need to ensure that the ship carries a "Polar Ship Certificate", a polar water operation manual, the proper training certificate from the respective flag state as required by chapter 12 in the Polar Code on board. The crew needs to perform voyage planning before every voyage, following instructions in the Polar water operational manual as required in chapter 11. Pollution prevention documentation needs to be updated to take operation in polar waters into account, including requirements from MARPOL.

2.2.5 Polar code training courses

To ensure that personnel working on ships in polar waters, courses were developed to meet the functional requirements set in chapter 12 in the Polar Code. The courses are made for the personnel in charge of navigational watch and is setting minimum training requirements for personnel working on ships holding a Polar Ship certificate and operating in polar waters.

Shipowners need to ensure that officers on SOLAS ships operating in polar waters have completed special ice navigation training and have the necessary competence to carry out their duties (DNV, n.d, a). The courses are made to comply with the requirements in The Polar Code and the STCW code for officers in charge of navigation, chief officers, and masters on ships operating in polar waters. The courses provide the participants with practical knowledge and theoretical background to successfully navigate in ice-covered areas. There are two types of courses to comply with the requirements, one basic and one advanced course. After completing these courses, the seafarer needs to document successfully completed training from an approved institution and have two months of seagoing service in polar waters, to apply for a Certificate of Proficiency Polar Code.

There are several providers of this kind of course in several countries, both close to the Polar region and in other countries. For example, in Norway, there are several course centers approved by the Norwegian Maritime Authority. Tromsø, Bodø, Ålesund and Haugesund all offer both basic and advanced training courses. Other maritime nations such as Japan, The Netherlands, Russia, and Scotland also offer the Polar Code courses.

2.2.5.1 IMO model courses 7.11 and 7.12

IMO has in collaboration with a training institute in Canada, developed model courses to assist maritime training institutes in organizing and introducing new training courses or enhancing, updating, or supplementing existing training material to improve the quality and effectiveness. The objective of the model course 7.11 (CMS, 2016a) by IMO is:

"A trainee successfully completing this course will gain:

- The ability to contribute to safe operation of vessels operating in polar waters
  - *Understanding of ice characteristics and areas where different type of ice can be expected in the area of operation,*
  - *Understanding of vessel performance in ice and low air temperature,*
  - *Understanding of safe operations and ship maneuverability in ice.*
- Awareness to monitor and ensure compliance with legislative requirements
- Understanding to apply safe working practices, respond to emergencies
  - *Understanding and awareness of correct crew preparation, working conditions and safety,*
- Understand the need to ensure compliance with pollution- prevention requirements and prevent environmental hazards

- Understanding skills to perform manoeuvres in order to safely operate in polar waters" (CMS, 2016a, pp. 7-8)

The model course (CMS, 2016a, pp. 9-10) has requirements for the instructors that will deliver the course, they should have:

- Appropriate training in instructional techniques and training methods, and recommended that they are experienced in operating ships in polar waters
- Detailed knowledge of the requirements of preparation of a vessel operating in low air temperatures
- Up-to-date knowledge of ice classes and equipment requirements to navigate in ice
- Knowledge of crew preparation, working conditions and safety in polar conditions
- Knowledge of pollution-prevention requirements

Both model courses have "Crew preparation" as a subject, where the participant should have knowledge, understanding, and proficiency regarding: Basic knowledge of crew preparation, working conditions, and safety. Recognize limitations of SAR readiness and responsibility, how to establish and implement safe working procedures for crew specific to polar environments such as low temps, ice-covered surfaces, PPE, use of buddy system, and working time limitations. Recognize dangers when the crew is exposed to low temperatures. Human factors including cold fatigue, medical first-aid aspects, crew welfare, survival requirements including use of personal survival equipment and group survival equipment, recognize fatigue problems due to noise and vibrations, identify the need for extra recourses, such as bunker, food, and extra clothing (CMS, 2016a, pp. 47-50).

The objective for advanced training ice navigation in polar waters model course 7.12 (CMS, 2016b, pp. 7-8) is:

"A trainee successfully completing this course will gain:

- The Understanding of the basic requirements for structure, stability and subdivision, machinery, life-saving appliances, fire protection, voyage planning, ship routing, navigation systems and equipment, radio communication, pollution prevention equipment, liability and safety management systems, as applicable to the different types and sizes of ships which may undertake voyages in polar waters

- The ability to contribute to safe operation of vessels operating in polar waters
    - *Understanding of ice characteristics and areas where different type of ice can be expected in the area of operation,*
    - *Understanding of vessel performance in ice and low air temperature,*
    - *Understanding of safe operations and ship maneuverability in ice.*

- Awareness to monitor and ensure compliance with legislative requirements

- Understanding to apply safe working practices, respond to emergencies
    - *Understanding and awareness of correct crew preparation, working conditions and safety,*

- Understand the need to ensure compliance with pollution- prevention requirements and prevent environmental hazards

- Understanding skills to perform manoeuvres in order to safely operate in polar waters

The standards expressed in the Guidelines have been developed to mitigate the additional risk imposed on shipping due to the harsh environmental and climatic conditions existing in polar waters."

The minimum qualifications recommended in the model course 7.12 (CMS, 2016b, p. 10) for instructor in charge of delivering the course are:

- Appropriate training in instructional techniques and training methods. It is recommended that all training and instruction are given by qualified personnel experienced in operating ships in polar waters.
- Detailed knowledge of the requirements of preparation of a vessel for operating in low air temperature;
- Up-to-date knowledge of the various ice class and equipment requirements to navigate in ice;
- Up-to-date knowledge of correct crew preparation, working conditions and safety in ice conditions and low temperatures;
- Be fully aware of need to ensure compliance with pollution-prevention requirements and prevent environmental.

2.2.5.2 Basic Training Ice Navigation in Polar waters, 7.11

The basic training course is to provide the officers in charge of a navigational watch with training to operate ships in polar waters and address the additional provisions as required by the Polar Code, to meet the safety and pollution prevention standards.

Subjects to be addressed in the basic model course are: Ice nomenclature, characteristics and detection, regulation and standards, vessel characteristics, maneuvering in ice, voyage planning and reporting, icebreaker assistance, vessel performance in polar Waters/Low Air Temperature, Crew preparation, Working conditions & Safety, and Environment. (IMO, 2016)

After completing the approved basic training in polar waters (Table A-V/41), a Certificate of Proficiency Polar Code – Basic may be issued to the person completing the course.

2.2.5.3 Advanced Training Ice Navigation in Polar waters, 7.12

To apply for the Certificate of Proficiency Polar Code - Advanced in Norway – the seafarer needs; a valid health certificate, have at least two months of sea service in polar waters or equivalent as a master, chief mate, or officer in charge of navigational watch, valid basic training (A-V/4-1) and advanced training (A-V/4-2), and a copy of the Certificate of competence deck officer (Norwegian Maritime Authority, u.d.).

The Norwegian Maritime Authority had a transitional provision for CoP Polar Code for seafarers who could document their seagoing service on ships operating in polar waters prior to 1 July 2018.

2.2.5.4 Arctic Polar Code Survival Training

Aboa Mare, a Finnish Maritime Academy and Training Center offers a training course focusing on how to survive in arctic temperatures for up to 5 days after evacuation (Aboa Mare, 2021). The course meets the minimum requirements for survival training in arctic conditions after possible ship evacuation set by the Polar Code regulations. After completing the training, the participants will be able to lead evacuation operations and take care of crew and passengers, understand how to manage difficult physical and mental conditions, be familiar with proper procedures on what to do after an evacuation, and know how to survive in arctic temperatures up to 5 days after evacuation. In addition, the participants will learn how to use the survival kits, set up camp and create shelter in arctic conditions, get experience with what can happen in an extreme emergency situation mentally and know-how to behave in this kind of extreme situation. The course is held outdoors in northern Finland during the winter.

2.2.5.5 "Train-the-Trainer" workshops

The Government of Canada provided expertise and financial support to develop and provide four regional capacity-building "train-the-trainer" workshops. The workshops aimed to enhance both the skills and competence of maritime instructors providing ice navigation training. The goal was to have persons from IMO member states involved in navigation in polar water attend the workshops (Engtrø, 2021).

During the Canadian workshop, the main priority was the various methods of teaching to be useful in the delivery of ice navigation training, rather than focusing on specific topics. The workshop was attended by both experienced and inexperienced personnel; therefore, the aim was how to develop ice navigation courses. The objective was to get the participants to understand the possible achievement of utilizing practical exercises rather than turning the course into a lecture. According to Engtrø, who interviewed participants of the "train-the-trainer" workshop in Canada, the participants desired more practical training and discussions and less lecturing. However, more lectures about ice recognition were requested (Engtrø, 2021).

3 Methodology

The thesis is a part of the master program "Technology and Safety in the High North" at UiT – The Arctic University of Norway. Since I have been working full-time during my master's studies as an officer on different ships with rotation, the work on this thesis started in February 2021 and ended in December 2021. This chapter gives an overview of the methods used to identify the gap in the existing training and describes the data collection to answer the research question below.

> "Are the polar training courses increasing the safety of persons onboard ships operating in polar waters, and are these courses sufficient?"

3.1 Selection of methods

To investigate the research question, data was collected. The primary methodology has been literature studies, reading research on studies done regarding the Polar code, and analyzing the documents found on the subject.

- "Literature review" includes reviewing time schedules from different training institutions and reviewing existing rules, regulations, and research reports like SARex.
- "Questionnaire survey" related to the competence of seafarers working in polar waters was distributed to a small, hand-picked group.
- Qualitative interviews were conducted involving an in-depth understanding of the problems regarding the competence level in polar waters. However, this method is time-consuming and was therefore only done on a small group of people.

3.1.1 Reasons for selection of methods

In order to identify the competence gap, both qualitative and quantitative data need to be collected. By doing a document analysis on other research done on this theme, reading the codes and regulations that set minimum requirements for seafarers, researching the different courses provided by different institutions, much of the information was gathered. Furthermore, a questionnaire to collect data was distributed to understand better the seafarers working in this environment and those who train the seafarers. The qualitative data collection was done by using open-ended questions on the questionnaire and the conduction of some in-depth interviews, see Appendix I.

3.1.2 Limitations

In seeking responses from personnel familiar with operations in polar waters, it was challenging to receive responses from many participants on the questionnaire; this limits the data collection. A qualitative analysis of the questionnaire methodology and literature review was most relevant for this thesis as quantitative research was not possible due to time constraints. Meaning the results from the questionnaire have not been analyzed mathematically.

3.1.3 Target group selection and distribution of the questionnaire

The survey target group were identified based on the following factors:

1. Geographical area: The Arctic and Antarctic waters (Polar regions).
2. Seafarers with experience from polar waters.
3. Authorized Training institutes for Polar Code training.
4. Researchers who have researched the Polar Code.

Based on these factors, a small number of respondents were identified with the help of the supervisors of this thesis. The authorized training institutions were found on the approved list by the Norwegian Maritime Authorization and google by searching ´Polar Code training´. The questionnaire survey was distributed as a word document by email divided into two categories: one for seafarers/researchers and one for the training institutions. Attached with the questionnaire was a description of the intentions for the questionnaire was and the promise of anonymity.

3.2 Data collection survey

A questionnaire survey was distributed to people with different experiences from polar waters and to training institutes to collect data on the courses, and their feelings about the course they attended or provide to further research the knowledge gaps. This was done to see if the people working closely with the polar code could identify some knowledge gaps. In addition, different training institutes provided their timetable on the polar code courses. The questionnaire included ten questions for the training institutions personnel and eleven questions for the seafarers. All the questions were open-ended to collect deep insight into the questions, allowing the respondent the freedom to express their knowledge and personal opinions in more detail. The questionnaire is attached in appendix I.

3.2.1 Qualitative interviews

Based on the questionnaire, a few qualitative interviews were conducted to gather more data. The number of interviews conducted depends on the availability of individuals and their approval. The interviews were semi-structured to gather information with open-ended questions, making the interviewees voice their thoughts about the theme. Since all the interviewees were not located in Tromsø, face-to-face interviews were hard to do. Face-to-face interviews give more accurate results, but interviews over Microsoft Teams were an option. This makes it possible to interview people located at other locations. The downside of doing interviews is that you need consent to record it or take notes. In this research, some interviews were taped and transcribed, and during others notes were just taken. Four participants with experience from polar waters participated in the interviews. Chapter 4.3.2 will discuss the details of the interviews and the participants' insights of the theme.

3.3 Literature review

Literature review was used to research existing literature on the topic and to identify possible knowledge gaps. To conduct a literature review, I've used google scholar, Munin (UiT library service), and I have had help from my supervisors to find relevant thesis and articles.

Traditional review was used to identify, analyze, and interpret literature on the topic, including the comparison of the time schedules for the polar code courses provided by different institutions.

Some training institutions could not to provide their time schedules for the courses due to data protection and copyright issues by the respective institutes. But thankfully, several training institutes provided their schedule for comparison.

3.4 GAP Analysis

Doing a GAP analysis makes it possible to analyze the state of the art and describe the desired state in the future. The method can make the gaps visible and identify possibilities to close the gaps. A gap analysis aims to determine the difference between the actual state and a desired future state. Analyzing the rules and regulations regarding the minimum standard competence of seafarers, will hopefully help identify gaps in the existing training.

The four steps of a gap analysis are:

1. Identify the current situation: Define what is important
2. Set S.M.A.R.T goals of where you want to end up: Specific, measurable, achievable, relevant, and time-sensitive.
3. Analyze gaps from where you are to where you want to be: Evaluate the gaps.
4. Establish a plan to close existing gaps

Doing a GAP analysis on the existing training will possibly identify gaps regarding seafarers training for work on ships operating in polar waters.

4 Results and data analysis

As concluded in above discussion regarding the activity around the poles, it can be extremely challenging to navigate in the Arctic waters. Hence, doing a gap analysis to identify gaps in the existing rules and regulations regarding competence for seafarers working in polar Waters is considered useful.

The rules and regulations covering commercial shipping are vague regarding specific training to sail in the challenging waters surrounding the poles. As per now, the only requirements in the Polar Code regarding crew is that those in charge of navigational watch have a polar water training course. The cold climate affects the personnel working on ships independent of their position on board. As seen in the SARex2 (Solberg, et al., 2017) surviving in the Arctic climate is challenging both as a group and as an individual. Training in the cold environment would make seafarers more prepared for the situations they may encounter. Basic operations will be different from other climates, and emergencies will represent real challenges due to the complexity of a rescue operation in the polar waters. This results in more responsibility for each seafarer when working in this climate. Research shows (Solberg, et al., 2016, p. 73)that the more training a person has to handle situations, the better the person is prepared to act in a situation. By focusing on STCW, SOLAS, and the Polar Code, the goal is to understand the legal framework the maritime industry is working with and must comply with during operations in polar waters.

As seen in the risk analysis for evacuation of vessels in Arctic Waters in SARex2 (Solberg, et al., 2017, pp. 103-121), better training of crew was listed under risk reducing measures on a lot of the hazards identified. This emphasizes the importance of well-trained crew during an emergency.

The goal for the future is more competent seafarers prepared for the challenges faced when operating in the challenging waters, and capable of handling all types of situations that may occur in these waters. In polar waters the seafarer may face additional challenges not accounted for in the STCW requirements. The cold, harsh climate presents dangers to crew and passengers in the event of an evacuation, in addition there are limited SAR recourses in the areas and inadequate infrastructure. A seafarer is expected to handle different types of emergencies, but the additional hazards present in polar waters may not be common knowledge. If the ship is carrying passengers, the passengers may look to the seafarer for help regardless of their position onboard the ship. Seafarers on ships operating in polar waters need to know about the challenges present in the waters; cold climate, ice, changing weather, windchill effect, survival in survival craft for several days, setting up emergency camp, organization of campsites, and have some leadership experience. Due to the remoteness and limited SAR recourses, the expected time to rescue is longer than in waters with more ship activity and closer to land, there are higher expectations to the individual seafarer.

As seen in previous research, the crew's competence in emergencies is essential for a successful evacuation (Solberg, et al., 2017). By implementing requirements in the Polar Code covering all crew working on ships who are obligated to follow the Polar Code, there will be an increased probability of handling an emergency correctly. An experienced crew will have a higher chance of success. In implementing a requirement to training for all crew in the Polar Code, the companies will have to follow the requirements and cannot choose not to train the crew to be prepared to face the challenges they may encounter in a cold climate. The training presented in the Polar Code should not be limited to those in charge of navigational watch but include all crew present at voyages in polar waters in order to prepare them for unforeseen situations. Mona R Chaure's findings in her thesis regarding "Preparatory Education of Crews and Passengers for evacuation in Cold Climate" (Chaure, 2020) states that it is necessary to develop a survival training module for cruise passengers. A training module concerning the use of safety equipment, muster drill importance, and awareness about cold-weather survival would make the evacuation of passengers easier for the crew on ships carrying passengers. Mona also states that the Basic and Advanced modules in the Polar code need to include requirements during an evacuation. The applicability should be related to cruise ships, and the training guidelines should be updated to cover practical evacuation skills and handling of personal survival kit, group survival kit, and life-saving appliances.

Skills gap analysis ⚓

Course	Officers (bridge)	Officers (Machine)	Able seamen	Other crewmembers
Advanced safety training	✓	✓	✗	✗
Basic Safety Training	✗	✗	✓	✓
Polar code course	✓	✗	✗	✗

Figure 20 - Skills gap analysis for seafarers regarding safety courses and Polar Code course

Figure 20 shows the training courses the seafarers need, based on their position onboard; as seen in the figure, officers need advanced safety training, and other crewmembers need basic safety training. This excludes other crewmembers than officers from participating in the Polar Code training courses.

Rather than having more seafarers in different positions onboard a ship completing the Polar Code training course made for those in charge of navigational watch, it could be possible to either develop a new polar safety training course regarding survival in polar waters for all or a percentage of the crew operating in polar waters or add more survival training regarding cold climate into the already existing basic safety training course. This would be a new, practical course focusing on the basic knowledge needed to survive in the polar after a maritime accident. During an evacuation from the ship; how to behave during a longer stay in a survival craft, and surviving on land will be challenging - using the identified risks in the Polar Code, which makes survival hard, could be used as the base for the course. By teaching the course participants how to dress, act, lead, organize and build an emergency camp, all the participants would know to reduce heat loss and dehydration, and improve basic leadership skills.

In addition, several of the interviewees pointed out that companies should have a broader knowledge about the challenges in polar waters. Therefore, to provide the management with basic information, participation in the basic polar code course could be a possibility. This could give the companies a greater understanding of the masters or other seafarers choices in polar waters and make them understand the Polar Code more.

4.1 Polar code courses

To obtain a Polar Ship Certificate, the ship needs to comply with the Polar Code. Chapter 12 in the Polar Code is about manning and training. To comply with the training requirements, different course providers offer "Polar code courses", which are made to comply with the minimum training requirements stated in the code. The polar code courses have different names depending on the provider, but the most used names are "Basic/advanced ice navigation in polar waters" or "Basic/advanced polar code course".

To assist in identifying the competence gap, different course providers have offered their schedules for their courses to make it possible to compare them to the IMO model courses and with each other. Specifically, several course providers approved by the Norwegian Maritime Authority have offered their schedules for analysis and comparison.

Based on the contact with course providers, most of the providers built their course on the IMO model courses 7.11 and 7.12, which are made to assist maritime training institutes in organizing new courses and make improvement to existing courses. The model courses are designed to identify basic entry requirements and specify the technical content and levels of knowledge and skill necessary to meet the intent of the IMO conventions and related recommendations. As seen in Table 5, the recommended course time is 34 hours for the basic course, including lectures, simulation, classroom exercises, and evaluation.

*Table 5 - Timetable for the IMO model course Basic (CMS, 2016a) * represents simulator training*

Subject Area	**Recommended Course Time (hours)**	**Recommended Method of Delivery**
1.0 Ice Nomenclature, Characteristics and Detection	5	Lecture, Class Room Exercise
2.0 Regulations and Standards	4	Lecture
3.0 Vessel Characteristics	2	Lecture
4.0 Manoeuvring in Ice	6 + 4*	Lecture + Simulation
5.0 Voyage Planning	2	Lecture, Class Room Exercise
6.0 Icebreaker Assistance	2 + 3	Lecture + Simulation
7.0 Vessel Performance in Polar Waters/Low Air Temperatures	2	Lecture
8.0 Crew Preparation, Working Conditions & Safety	2	Lecture
9.0 Environment	1	Lecture
Evaluation	1	Method to be determined
Total	26 + 7* + 1 = 34	Lecture + Simulation + Evaluation

Based on the recommended course time in the IMO model course 7.11, the timetables received from four different course providers are analyzed in Table 6 below, to see how they use time on different subjects on their course.

*Table 6 - Basic Polar Code course time, * represents simulator training, - represents missing data*

Subject area	**Course provider 1**	**Course provider 2**	**Course provider 3**	**Course provider 4**	**Recommended course time**
Ice nomenclature, Characteristics and Detection	1,75 + 2,75 + 0,75 = 5,25	1,75 + 2,25 = 4	5	1,75	5
Regulations and standards	1,5	1,75 + 1,5?	2	1,5	4
Vessel characteristics	1,75	1,5	1+1*	0,5	2
Maneuvering in Ice	3,75*	1,5	6+6*	3,75	6 + 4*
Voyage planning	1,75	1,75	2	2	2
Icebreaker assistance	- + 1*	-	1+4*	1,75	2+3*
Vessel performance in Polar Waters/Low Air temperatures	2,75	1,75 + 2,25 = 4	1+1*	1	2
Crew preparation, Working conditions & Safety	2,75 + 1,5 = 4,25	-	2	1	2
Environment	0,75	-	1	1,5	1
Evaluation	0,5	1,75	1	0,5	1
Total	21+3,75*=24,75	17,75 + 4* = 21,75	26+7*+1=34	23,5+ 6,5* =30	26 + 7* = 34

*Table 7 - IMO model course Advanced Polar Code, * represents simulator training (CMS, 2016b)*

Subject Area	Recommended Course Time (hours)	Recommended Method of Delivery
1.0 Regulations, Standards & Shipboard Documentation	3	Lecture and classroom exercise
2.0 Vessel Characteristics	1	Lecture
3.0 Manoeuvring in Ice	3 + 5*	Lecture, Case Studies + Simulation
4.0 Voyage Planning	4 + 2	Lecture, Class Room Exercise+ Simulation
5.0 Icebreaker Ops	3 + 5	Lecture, Case Studies + Simulation
8.0 Crew Preparation, Working Conditions & Safety	2	Lecture
Evaluation	2	Method to be determined
Total	16+ 12 + 2 = 30	Lecture + Simulation + Evaluation

Based on the recommended time in the IMO model course 7.12 for advanced training, see Table 7, the time schedules provided from two different course providers are presented below in Table 8.

*Table 8 – Comparison of Advanced polar code course, * represents simulator training, - represents missing data*

Subject area	Provider 1	Provider 2	Model course
Regulations, Standards & Shipboard documentation	3	5	3
Vessel Characteristics	1	2,5	1
Maneuvering in Ice	4+6*	4,25	3+5*
Voyage planning	3+2*	4,25	4+2*
Icebreaker Ops	2+4*	1	3+5*
Crew preparation, working conditions & Safety	3	4,25	2
Evaluation	2	0,5	2
Add: Environment	-	1	-
Add: Ice Characteristics	-	2,25	-
Simulator	-	7*	-
Total:	18+14*=30	25+7*=32	16+12*+2=30

Basic and Advanced course combined is a course some Norwegian maritime training centers offer; it is a hybrid of the basic and advanced courses, which offers the candidate to take both courses as one, Table 9.

*Table 9 - Comparison of basic and advanced courses combined, * represents simulator training, - represents missing data*

Subject area	Provider 1	Provider 2	IMO
E-Learning	18B + 14A	-	-
Ice Nomenclature, Characteristics and Detection	0,75+0,75B	1,75+2,25 +1,75+1,5	5
Environment	-	2,25	1
Regulations, standards & shipboard documentation	-	1,5	3
Vessel characteristics	0,66B	1,5	1
Maneuvering in Ice	0,75+0,75 +*	-	3+5*
Voyage planning	0,75*	1,75	4+2* 2 B
Icebreaker Ops	45+0,66+3,10*	1,75	3+5* 2+3* B
Crew preparation, working conditions & safety	0,75*+2,25	1,75+1,5+1,75	2
Vessel performance in Polar Waters/Low Air temperatures	1,25B+0,75	1,75	2
Evaluation	1,17	1,75	2
Total	32 + 32E = 64	38,75	34+30=64

As a part of the data collection phase, the Norwegian Maritime Authority provided statistics on how many persons have completed the polar code training courses at the approved training institutes in Norway. Figure 21 is based on the statistics (Amundstad-Balle, 2021), making it possible to see which age group has completed the different courses. However, the statistic provided excludes all seafarers born after 1993. Based on the figure, most of the persons who have completed the advanced training are above 28 years old, and the age group with the highest attendance is 37 – 41 years.

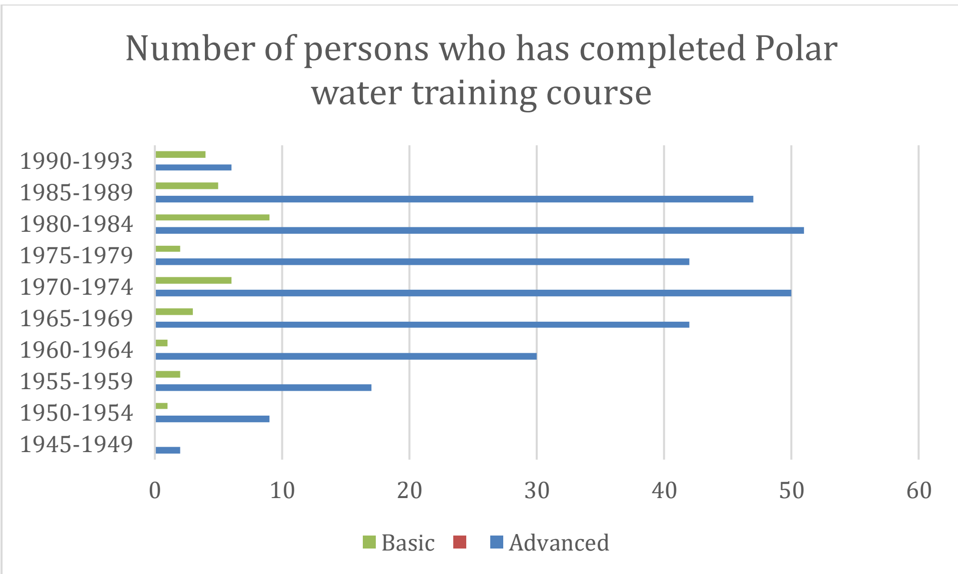


Figure 21 - Number of persons who have completed Polar code training born from 1945 – 1993 (Amundstad-Balle, 2021)

4.2 Survey

As a part of this thesis, a survey questionnaire regarding the polar code course was made, and the survey was distributed to a group of people working with or within the frames of the polar code and institutions that offer polar code training. The goal is to collect data from the people working in these waters and those who train the seafarers. Unfortunately, due to the limited time available to finish this thesis, it was hard to get sufficient data to do a statistical assessment of the collected data.

4.2.1 Data collection survey

In order to collect data, a questionnaire was made and distributed out to people with different experiences regarding the Polar Code, see Appendix I. Twelve questions to people who have attended a Polar Code course, and ten questions to people working on different training institutes. The questions were about their experience from the polar waters and the course. To the training institutes, the questions were about the course; how they have built it, how they determine how much time to use on each subject and the lecturer's experience. The questionnaire was in Norwegian to ensure that the participants would answer, and the participants' answers were anonymized in this thesis.

The questionnaire was distributed by e-mail, and since not everyone answered on e-mail, some Teams meetings, and some meetings in person were set up to ensure enough participants.

4.3 Survey results

In this chapter the results from the data collection phase are presented, both from the questionnaires and the interviews, Table 10.

Table 10 - Survey target group and respondents

Target group	What	Sent out to	Respondents
Training institutes	Time schedules	15	8
Instructors in Polar code training	Questionnaire	4	2
Seafarers with experience from polar waters	Questionnaire	4	4

4.3.1 Polar Code course survey results

As stated in the Polar Code (IMO, 2017a), Chapter 12, the goal is to ensure that ships operating in polar waters are appropriately manned by adequately qualified, trained, and experienced personnel. In order to comply with the goal, the companies shall ensure that masters, chief mates, and officers in charge of navigational watch have completed training to attain the abilities appropriate to their duties and responsibilities. In addition, the code states that all crew members shall be familiar with the procedures and equipment relevant to their assigned duties. Although experience is individual and something that comes over time when working, it is challenging to meet the goal of the Polar Code. Experience is hard to measure, and how can companies determine if their crew are adequately experienced?

The training requirements in the Polar Code is regarding the officers in charge of navigational watch, which the polar code courses are made to comply with. After analyzing the course schedules provided, most courses are based on the model course. However, the different providers have different lengths for their courses and different priorities on which subjects to use most time on. The hybrid of basic and advanced courses is combining two courses which the model courses recommend using 30 and 34 hours on and making it into one course. However, it is impossible to compare the hybrid version to the model course since the model courses are two different courses. As seen in table 9, course provider 1 use E-learning to shorten the time at the training institute. This seems like an excellent way to take the basic and advanced course as one by combining e-learning with lectures, classroom exercises, and simulator training.

The difficulty with comparing the different time schedules is that not all of them specify which subject is the background for the time used on the simulator, and they are not built up the same way.

As seen in Table 5, the recommended course time per the IMO model basic ice navigation course is 34 hours; based on the time schedules provided, only “provider 3” meets the recommended course time. Provider 1 has a course lasting almost 25 hours, meaning that there are 9 hours reduced from the model course, provider 2 also cuts the time based on the recommended time with a course of almost 22 hours, meaning that there are 12 hours less than recommended. Provider 4 has not included which subjects the simulator exercises will focus on, but the course is 30 hours, and 6,5 of them are used on simulator exercises compared to the model course recommending 7 hours on simulator exercises.

In Table 8, the Advanced polar training course is compared. The IMO model course 7.12 has a recommended course time of 30 hours; as seen in Table 8, both providers meet the recommended time, and provider 2 has an additional 2 hours.

In addition to the basic and advanced courses, some training institutes offer combined basic and advanced polar training. This version of the course would have a recommended time of 64 hours based on the IMO model courses. However, the providers have solved this in different ways. For example, provider 1 in Table 9 uses E-learning for shortening the time at the training institute, making it the only provider to meet the recommended time.

The “train-the-trainer” workshops were developed so the MET trainers would gain skills and competence, which they later would transfer the outcome from the workshops to their flag state authorities and MET institutes. However, a problem at the Canadian workshop was that some of the attendees lacked relevant qualifications, this limited the goal of reaching out to as many qualified MET instructors as possible during the workshops (Engtrø, 2021).

4.3.2 Questionnaire results

When distributing the questionnaire to a limited number of hand-picked persons to provide information on a theme they were familiar with, a questionnaire was a good way to gather information from their viewpoint and experience. Many participants had a lot to talk about regarding the Polar Code when answering the questions in person versus a shorter reply when answered on email.

4.3.2.1 Questions from the questionnaire to seafarers with answers

The questions from the questionnaire translated from Norwegian:

1. What are your thoughts on the Polar Code?
2. Do you have experience with polar waters? If yes, what type of experience.
3. What is your role regarding the polar code? (Instructor at course/seafarer/research)
4. Have you taken the basic or advanced polar code course? If yes, when and where?
5. What is your perception of the course/courses?
6. Do you feel that the time used on different subjects was sufficient?
7. What subjects did you think were good and less good regarding your experience with the code or polar waters?
8. What do you think about the time used on the different subjects? What could be focused more on?
9. In hindsight, what could have been done differently regarding the completion of the course you attended?
10. Do you think that the Polar Code is increasing the competence level in polar waters?
11. How do you think it is possible to improve the competence of the maritime industry in polar waters?

The persons who received the questionnaire have similar backgrounds; all participants have operational experience from ships operating in polar waters, and experience as either a lecturer or guest lecturer on a polar code training course. Several of the participants have also been included in research projects regarding the Arctic and the Polar Code.

In the tables below the answers are presented.

Table 11 - Answers to question 1 from the questionnaire

Question 1	Answers	Summary
Participant 1	A set of rules that helps increase the safety regarding maritime operations in polar waters.	
Participant 2	Important and interesting code, positive for the safety in polar waters. A bit disappointed in the outcome, it should be harder to comply with the code, but the code has increased safety and is better than nothing.	
Participant 3	Thinking that the Polar Code was necessary and reasonable. It was not implemented too early, but all codes and regulations intend is to prevent accidents, so it was essential to set the	

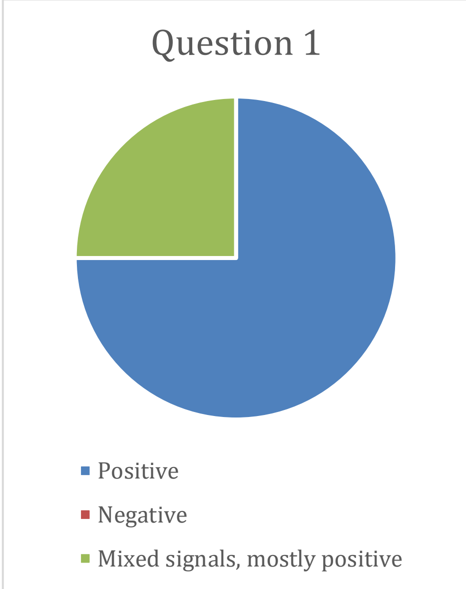
<table>
<tr><td></td><td>code into force. There was a gap between the increased activity and the existing rules and regulations. It was good that the code included the competence requirements.</td><td rowspan="2"></td></tr>
<tr><td>Participant 4</td><td>Very good that there are rules that ensure safer operation of ships in polar waters. It seems that it is at a good place regarding courses and certification of seafarers. Making it harder for “anyone” to sail to polar waters without understanding the area, with the challenges regarding SAR and the climate. Since the consequences of a maritime accident in polar waters may potentially be significant, work regarding the competence of seafarers is essential to avoid accidents.</td></tr>
</table>

Table 12 - Answers to question 2 from the questionnaire

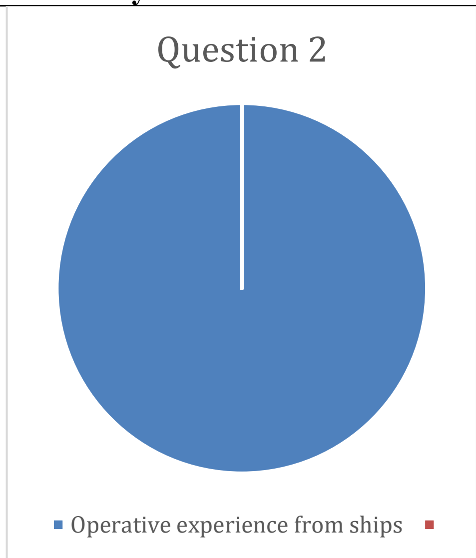
<table>
<tr><th>Question 2</th><th>Answers</th><th>Summary</th></tr>
<tr><td>Participant 1</td><td>Yes, both as a seafarer and work for maritime organizations.</td><td rowspan="4"></td></tr>
<tr><td>Participant 2</td><td>Yes, 10+ years on icebreaker and experience as a leader on bigger maritime operations in Arctic waters. In addition, worked with the polar code.</td></tr>
<tr><td>Participant 3</td><td>10+ years on a ship working in arctic waters on icebreaker service, and experience as course instructor.</td></tr>
<tr><td>Participant 4</td><td>Worked on a ship operating in arctic waters year-round.</td></tr>
</table>

Table 13 - Answers to question 3 from the questionnaire

<table>
<tr><th>Question 3</th><th>Answers</th><th>Summary</th></tr>
<tr><td>Participant 1</td><td>Instructor, seafarer, and researcher. Seven years in total with all the categories.</td><td rowspan="2"></td></tr>
<tr><td>Participant 2</td><td>Instructor, operational experience as a seafarer and in administration in both companies with ships operating in polar waters and adviser in different polar operations. Has also worked with making recommendations regarding</td></tr>
</table>

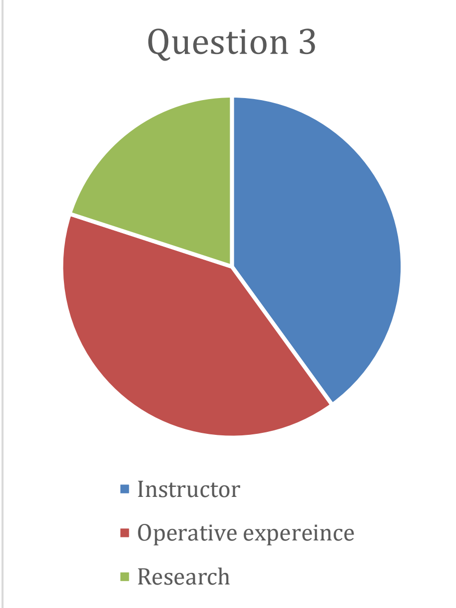
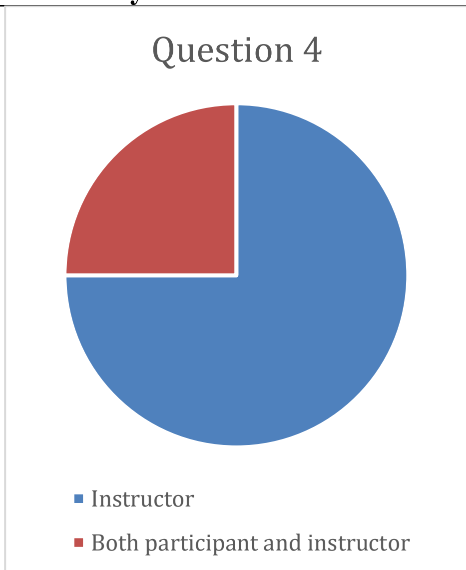
	sailing routes in the waters surrounding Svalbard.	
Participant 3	Responsible for the polar code course, operational experience as a seafarer on an icebreaker, research regarding exercises done to research the polar code.	
Participant 4	Operational experience as an officer on an icebreaker, involved in research as a leader in exercises, also some instructor experience from polar code courses.	

Table 14 - Answers to question 4 from the questionnaire

Question 4	**Answers**	**Summary**
Participant 1	Have been a guest lecturer at the course.	
Participant 2	Took the course in Sweden in 2017 and have been an instructor as well.	
Participant 3	Have not attended the course but works as an instructor. CoP Advanced due to experience.	
Participant 4	Course instructor, focus on operations in ice, voyage planning. Has not attended the course but has the advanced Certificate of Proficiency polar code due to his experience in polar waters.	

Question 5	**Answers**	**Summary**
Participant 1	Good.	
Participant 2	Good, the course he attended and held was improved based on the feedback from the course participants.	
Participant 3		

Participant 4	Thinks that the course he has been a guest lecturer at seemed good.	

Table 15 - Answers to question 6 from the questionnaire

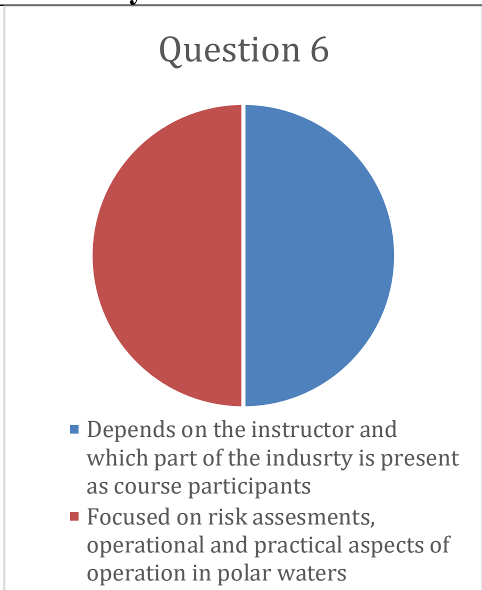
Question 6	Answers	Summary
Participant 1	It all depends on those who lead the course and which parts of the industry are present as students.	
Participant 2	Focused a lot on risk assessment and how to handle weather and ice data., focusing on both the practical and operational aspects.	
Participant 3		
Participant 4		

Table 16 - Answers to question 7 from the questionnaire

Question 7	Answers	Summary
Participant 1	Good: concrete discussions based on the course participant's own experience. Bad: When it gets too theoretical.	
Participant 2		
Participant 3		

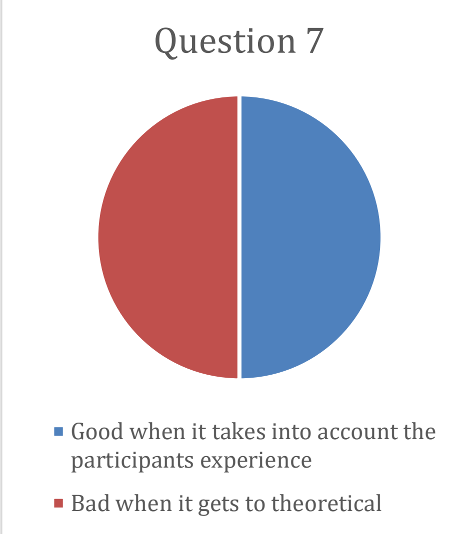
Participant 4		

Table 17 - Answer to question 8 from the questionnaire

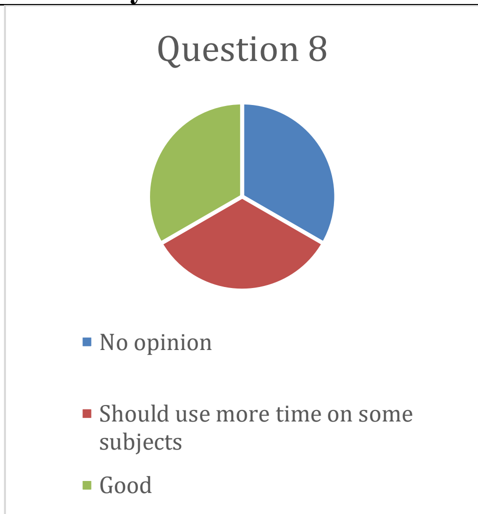
Question 8	Answers	Summary
Participant 1	No opinions regarding this.	
Participant 2	Use more time on the planning and risk assessments.	
Participant 3		
Participant 4	Thinks it is a good way the course is built up.	

Table 18 - Answer to question 9 from the questionnaire

Question 9	Answers	Summary
Participant 1	Depends on the course provider.	
Participant 2		
Participant 3		
Participant 4		

Table 19 - Answers to question 10 from the questionnaire

Question 10	Answers	Summary

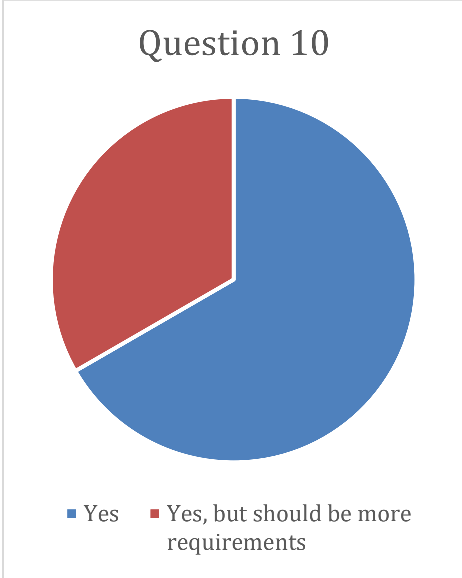
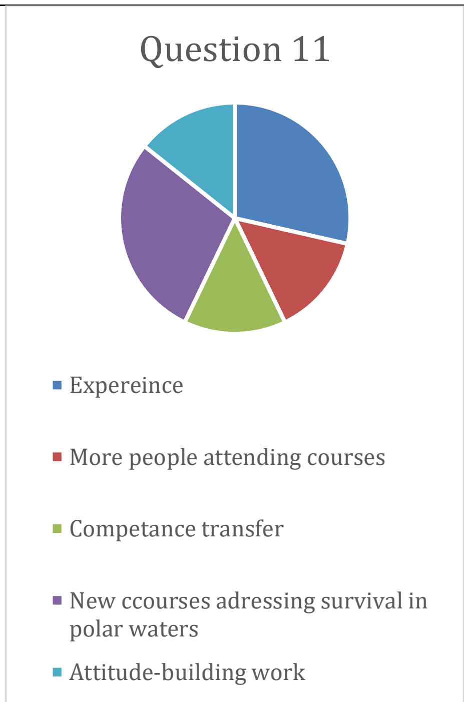
Participant 1	Yes, for incompetent operators, it increases the minimum level of competence.	
Participant 2	Absolutely, better than nothing. However, I think the requirements are a bit light, should be more demanding requirements.	
Participant 3		
Participant 4	Yes, no doubt. Before the Polar Code, there was no way to ensure everyone had competence. It increases the minimum level of competence. The code ensures that there is a minimum level of competence of those operating in polar waters.	

Table 20 - Answers to question 11 from the questionnaire

Question 11	**Answer**	**Summary**
Participant 1	Trough practical operations and attitude creating work.	
Participant 2	The companies should send more crew on courses and staff the ships with extra crew to get more experienced crew.	
Participant 3		
Participant 4	Competence transfer between crewmembers. Furthermore, in the long run, maybe expand the safety training so that everyone can take a leading role in a survival craft to increase the possibility of survival in polar waters. Since the Polar Code has not set any requirements regarding the competence of a survival craft leader in polar waters.	

4.3.2.2 Questions from the questionnaire to the providers of the polar code courses with answers

1. Do you feel that the IMO model course covers all the lecturers should focus on to increase the competence of the participants?
2. How do you use the time on the different subjects compared to the IMO model course?

3. Do you see any problems with shortening the course you offer compared to the model course?
4. How do you decide which subjects are important and less important regarding subjects that are less time used on?
5. Are there any subjects that you find essential that are not covered by the model course?
6. Do you feel that there is sufficient time used on simulator training?
7. Do you feel that the instructors on the course you provide are qualified in accordance with the requirements given in the model course? :
   - Appropriate training in instructional techniques and training methods, and recommended that they are experienced in operating ships in polar waters;
   -Detailed knowledge of the requirements of preparation of a vessel operating in low air temperatures;
   - Up-to-date knowledge of ice classes and equipment requirements to navigate in ice;
   - Knowledge of crew preparation, working conditions, and safety in polar conditions
   -Knowledge of pollution-prevention requirements)
8. Is it important for you that the instructors on the course have experience from polar waters?
9. As an instructor, do you feel that the course participants are ready to face the challenges present in polar waters after completing the course?
10. Should it be required that more personnel involved in polar maritime activity attend the polar code courses (Basic and/or Advanced)?

It was challenging to get answers from the questionnaire to the providers of the Polar Code training courses, therefore individual interviews were conducted to get some answers on the questionnaire. The qualitative in-depth interviews were based on the questionnaire as an interview guide; the interviewees have experience from polar waters and working with the Polar Code, either on ships, research, or with the Polar Code courses. One of the interviews was conducted over Microsoft Teams, the other were done in person. When answering the questions during an interview, it was easier to get the participant to elaborate more about the Polar Code and their experience with polar waters and the courses.

In the tables below the answers are presented.

Table 21 - Answers to question 1 from the questionnaire to the course providers

Question 1	**Answers**	**Summary**
Participant 1	This person has formerly held the course; they have built the course	

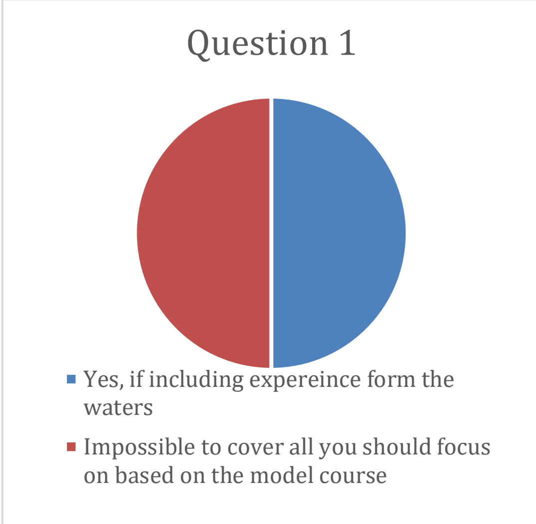
	on the IMO model course but used their extensive experience to make the course.	
Participant 2	The curriculum for a polar code course is extensive. It will be hard to cover all the aspects of the model course, so you need to decide what to dedicate the time on, which subjects to prioritize and go in-depth. Depending on the course participant's experience, which type of vessel, and their area of operation, the course will have to be adjusted to them. For example, a course for å cruise liner company that will sail towards the Antarctic Peninsula but not enter icy waters during the summer will not demand the same course as a course for a company with ships going into icy waters with an ice-classed vessel. As a course provider, it is essential to build the courses to the intended operation in polar waters. It is hard to have one course that will cover everything on a detailed level for every operation. The same subjects will be covered, but it is important to weigh the subjects based on their background. However, to be able to do the courses this way demands an experienced instructor.	

Table 22 - Answers to question 2 from the questionnaire to the course providers

Question 2	**Answers**	**Summary**
Participant 1	Focus more on the risk assessment phase.	

Participant 2	We make the courses based on the course participant's background, experience, and intended operation, meaning that depending on the participants, it depends on what we use most time on.	

Table 23 - Answers to question 3 from the questionnaire to the course providers

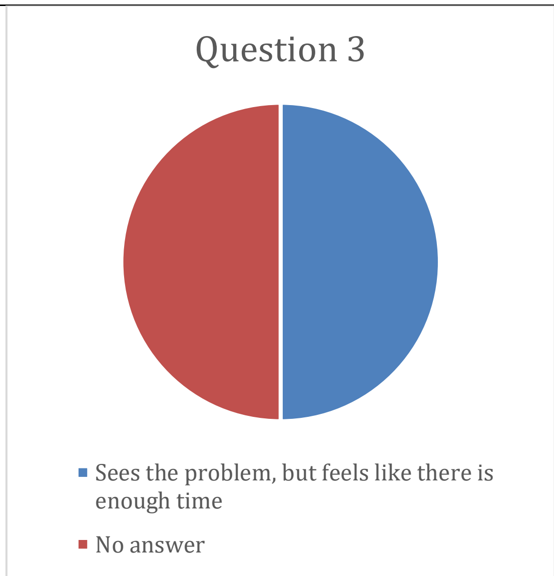
Question 3	**Answers**	**Summary**
Participant 1		
Participant 2	There is a problem with shortening the course. If there is not enough time to go through all the subjects, I feel that we can do this during one course week. It is impossible to learn everything no matter how long the course is; you need to form the course and choose what is important. It is no need to list the whole polar code or other rules and regulations. You need to introduce the subjects you mean are important to the participants and allow them the opportunity to read and understand relevant information by giving them a course pack with the Polar Code, relevant literature and showing them where to find information. So, if there is something that is not so relevant for the participants, you can find the information you need in the folder and where to find information regarding different areas. Thus, giving the participant the tools to increase their knowledge in addition to the things they learn on the course.	

Table 24 - Answers to question 4 from the questionnaire to the course providers

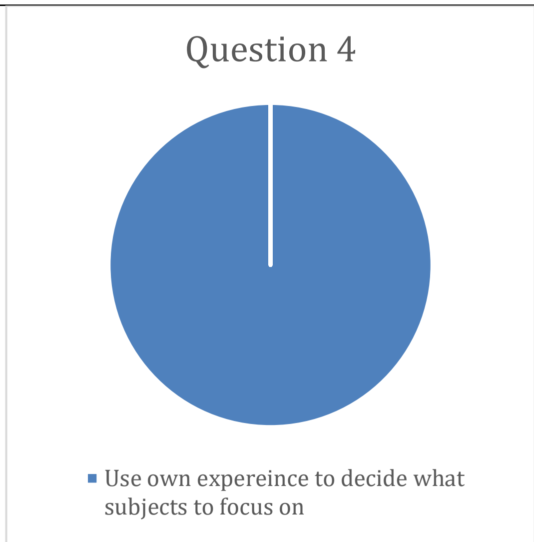
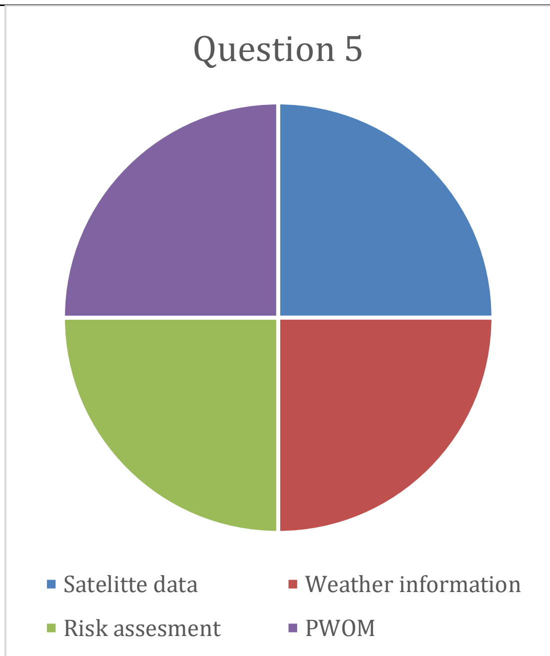
Question 4	**Answers**	**Summary**
Participant 1		
Participant 2	It is impossible to use the same amount of time on every subject, using the instructor's own experience and knowledge about the code and area to decide what is more important to focus on.	

Table 25 - Answers to question 5 from the questionnaire to the course providers

Question 5	**Answers**	**Summary**
Participant 1	More focus on satellite data, weather/ice information, and risk assessment. Learn the participant how to handle the weather information and the ice charts and how to get the information onboard.	
Participant 2	The course provided is based on the model course. The Polar Code is about risks – risk assessment, risk identifying, and risk mitigation. The risks will be focused on in voyage planning, which is one of the most important subjects. Based on the hopelessness involved in an accident in polar waters, voyage planning and risk assessments are crucial to avoid accidents. Instead of using 10 hours to lecture about the Search and Rescue services in polar waters, you can use 5 hours and the other 5 hours in the voyage planning. Explaining the risks present with polar water operations should motivate the participant to increase their knowledge regarding voyage planning since most accidents	

	happen due to human error that could be avoided. The participants need to make decisions based on the information they have available to do safe operations. In addition, the Polar Waters Operational Manual should be focused on, which should be guidelines for all operations. The PWOM should be used as a tool during the planning of an operation, and the seafarer should be able to identify faults in the PWOM based on their experience and make a revision. It is also important with experience transfers when new seafarers muster onboard.	

Table 26 - Answers to question 6 from the questionnaire to the course providers

Question 6	**Answers**	**Summary**
Participant 1		
Participant 2	Yes, half a day should be enough to show the participants the different challenges such as ice, poor visibility and weather, human factors, communication, and voyage planning. The course participants get a scenario, different ice charts, weather reports, and a task. Before starting the simulator exercise, they will do a risk assessment.	

Table 27 - Answers to question 7 from the questionnaire to the course providers

Question 7	**Answers**	**Summary**
Participant 1	The instructors need to have experience from polar waters.	

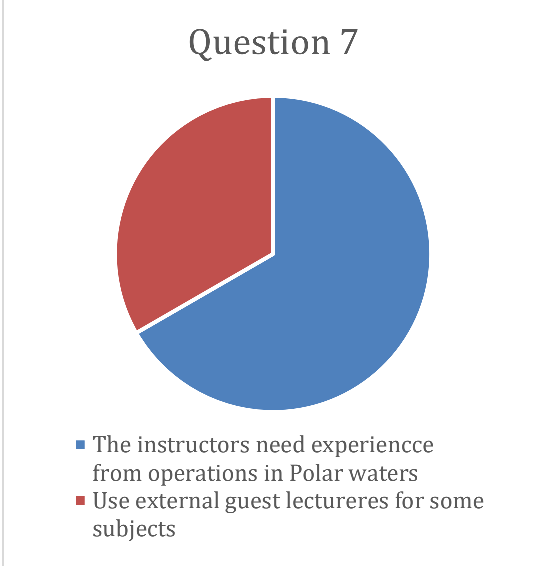
Participant 2	Yes, certified simulator instructors and instructors with operative maritime experience in polar waters. In addition, guest lecturers on subjects like winterization and environment are used. Because of the instructor's extensive experience from polar waters, crew preparation and working conditions are basic knowledge.	

Table 28 - Answers to question 8 from the questionnaire to the course proivders

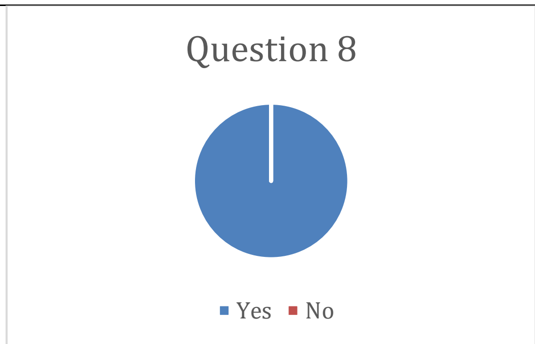
Question 8	**Answers**	**Summary**
Participant 1	Yes	
Participant 2	Yes	

Table 29 - Answers to question 9 from the questionnaire to the course providers

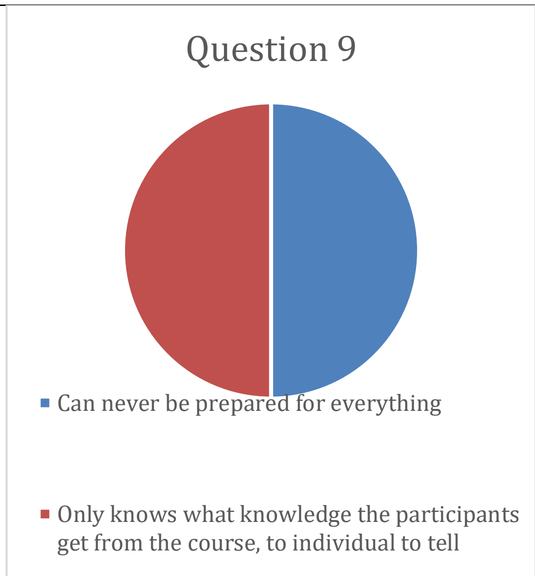
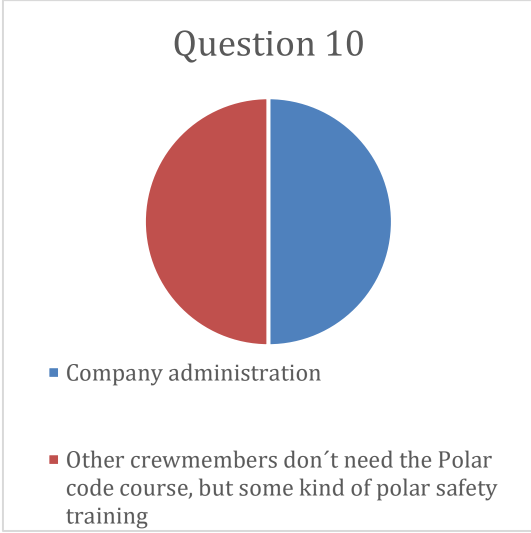
Question 9	**Answers**	**Summary**
Participant 1	You can never be prepared for everything. For example, operations during the summer can be problem-free, but operations during the winter may be another case.	
Participant 2	As an instructor, you cannot know. The only thing you know is what you give the course participants. The only quality assurance is the simulator exercise and the case they will solve and present. There is not an individual exam where they will answer questions, but the course participants will be evaluated on the case and the planning regarding the simulator exercise.	

Table 30 - Answers to question 10 from the questionnaire to the course providers

Question 10	**Answers**	**Summary**
Participant 1	Persons expected to lead in a survival craft should have a better understanding of survival in polar waters. Knowledge regarding hypothermia, moist and how to handle the situation.	
Participant 2	The administration in a company that has ships operating in polar waters may benefit from attending the course to increase their knowledge about the Polar Code and the requirements. However, it is unnecessary to make it a requirement for more people to attend the polar code course. Nevertheless, there should be a basic polar safety training course, like the existing basic and advanced safety training course. The course should introduce basic knowledge about survival in polar waters after a maritime accident. Focusing on the evacuation from a ship, survival in survival craft, survival on land in polar areas over time. By using the identified risks in the polar code and making a syllabus for the course. If a percentage of the ships key personnel had the course to sail in the Polar regions, learning about dressing after the conditions, behavior, leadership skills, organization of camp; to address the most important regarding survival; avoid heat loss, dehydration and know basic first aid.	

5 Discussion

In this chapter, the results from the data analysis are discussed. The data analysis from chapter 4 presents the findings on the existing basic and advanced polar training courses and the findings from the questionnaire.

Prior to the introduction of the Polar Code, there was a gap regarding the increased operations ongoing in polar waters and the existing rules and regulations covering the area. The Polar Code did close some of the gaps and was much needed to ensure the safety for both personnel and environment. The Code identified risks related to operations in polar waters and implemented risk mitigating actions through its recommendations. Overall, the code has increased the safety, but there are still some actions needed to be made to increase it further. A lot of work has been done regarding this; additional requirements have been introduced to the code, through interim guidelines (IMO, 2019), based on research making evacuation from ships in polar waters safer for those involved.

An emergency is a complex situation for everyone, no matter what kind of emergency. The most challenging is that in the remote polar waters, help may be challenging to get. Therefore, a well-prepared crew is crucial for an emergency in remote areas; in addition to all the challenges faced with in polar waters, a well-trained and experienced crew should be a top priority. Therefore, good and educational courses will give the seafarers the best possible basis to operate in polar waters. To achieve a crew prepared to face all the different challenges they may meet, good onboard training, different onshore courses, and an active approach to ensure safety should be implemented onboard all ships operating in the area. In the cases where ships are carrying passengers, to decrease the risk of challenging situation turning worse, it might help if other crewmembers than those in charge of a navigational watch could get more in-depth training regarding survival in a cold climate.

The IMO model courses seem to cover it all, but the providers that may have based their courses on the IMO model courses 7.11 and 7.12 will not give the same courses. The providers use less time on different subjects, and some may include additional themes they find relevant. The addition of relevant themes is great; if the lecturer is experienced in navigation in polar waters, he or she may have valuable input to make the participant of the course be better prepared for the actual situation. The combination of basic and advanced as one course may work if there is e-learning for some of the theoretical aspects of the courses. Analyzing the different course timetables was more complicated than expected since they do not use the same setup regarding the subject on the model course. As a result, some subjects are more mixed together than in the IMO model course, which is natural since some subjects overlap each other.

Based on the questionnaire survey, the providers see the problem with providing a course that does not comply with the recommended time in the model course, but it is a fine line between cost and safety. The companies often have to fly crewmembers to courses, leading to a lot of travel expenses; and if the courses are longer than a week, the expenses will increase due to travel back and forth twice as well as additional living expenses. However, one of the providers thinks that they can provide a good course even though it is not done at the recommended time because they offer custom-made courses to fit the participants regarding experience, area of operation, and ship type.

“Train-the-Trainer” workshops seem like a good idea if it is possible to exchange and transfer experiences and learning outcomes from the event back to the flag state authorities and MET institutes. However, after the Canadian workshop, the workshop’s outcome was not as intended; delegating the responsibility of transferring the learning outcomes from the workshop to the participant back to relevant stakeholders is considered a weak and unreliable way of sharing information. Thus, making it uncontrollable to assess and ensure compliance with the goals for the workshop.

According to Aboa Mare(2017), a well-known training center, the participants who have operated vessels in northern waters are usually well acquainted with navigating vessels through the ice. Therefore, they know how to deal with simulated events. However, other trainees, who only have experience with open-water navigation, will face several situations that they probably have not encountered before the start of training. Consequently, the training instructors need to dedicate much time to improving the skills of the trainees not familiar with ice navigation.

The few respondents on the questionnaires have consequences for this thesis because the number of respondents was too low for a significant response rate. Therefore, the collected data must be considered unreliable, but the data give some insight into the polar code courses. The low respondent rate may be due to low motivation in answering an e-mail distributing a questionnaire survey from a random student.

Based on the questionnaire results, the participants think that the Polar Code is good regarding maritime safety. However, there are some opinions the Code that it is too easy to comply with and that it did not come a second too soon, as the Code did close a gap regarding the operations in the area and the existing rules and regulations. In addition, the participants find it good that the code sets requirements regarding trained personnel, increasing the minimum level of competence for those in charge of the ship.

Both providers interviewed focus on risk assessment, risk mitigation, and risk identification. The goal is “no accidents”, and the best way to decrease the risk is to give the seafarers knowledge about the risks and how to avoid ending up in a situation that can lead to an accident. Due to the limited SAR recourses present in the polar regions, the best way to avoid an accident is by increasing the knowledge regarding voyage planning, motivating the course participants to increase their knowledge when made aware of the risks of operating in polar waters. Therefore, implementing a good and informative Polar Water Operational Manual, which is a document that should assist the navigation officer in voyage planning, and making revisions based on gained knowledge is essential for safe voyages.

The instructors of the courses only know what knowledge they offer to the participants, and the only way of controlling that a participant has an understanding, is by an exam at the end of the course. This exam can be done as a written exam or as a case study and a simulator exam. This results in the basis for the instructor’s evaluation of the students of the course. The students may be ready to face some of the challenges present in polar waters during the summer, but the situation may be entirely different during the winter. Therefore, the course instructors cannot assess the students’ ability to face all the different types of challenges present. However, the courses give the student a good basis and teaches them how to increase their knowledge.

The survey also gave valuable input on how experienced personnel thinks it is possible to increase the competence in polar waters, mainly regarding crewmembers other than bridge officers and the organization on land. Both of the participants who answered the course provider questionnaire does not think it is necessary to implement the polar code training for personnel in charge of navigation, to other crewmembers who do not participate in the navigation of the ship. However, the participants stated that other crewmembers should have some safety training regarding polar waters. This type of course could give them the knowledge to survive in polar waters. In addition, some stated that the company could increase their knowledge about polar maritime operations by sending some from the land organization on a basic polar code course to gain knowledge to better support their crew operating in polar waters. Another way to increase competence is through experience transfer, from experienced crewmembers to less experienced crewmembers, ensuring that all crew members know about the operations and possible hazards.

During one of the interviews, one of the participants talked about a fee for each passenger based on the ice class of the vessel, which may result in fewer ships far north and smaller ships with higher ice class operating in the high north. By making it more expensive to operate in the high north, the countries which is providing search and rescue services will be able to do their job easier. Less tourists means a decreased amount of SAR recourses needed in case of a maritime accident. This is one way to ensure the safety for the persons operating in polar waters. Another way of ensuring safety for both crew and passengers would be implementing a buddy system, meaning vessels operating in remote areas do it together with another vessel. In case of an accident, the buddy vessel would accommodate the crew and passengers of the ship involved in an accident since rescue in these areas is complicated due to long distances and climate conditions (Albrigtsen, et al., 2015). The buddy system can result in faster evacuation or rescue, immediate medical attention, providing additional resources to aid in or mitigate emergencies, identifying safety issues and consultation, and alternative perspectives on a specific work task. A buddy system could partly compensate for the current lack of SAR resources and function like a buffer in an unwanted situation until SAR resources come to aid.

Insurance companies have different requirements to provide insurance for sailings in polar waters, but the lack of data makes the risk assessment hard for the insurance companies. Different factors can influence the insurance premium for a shipping company and an insurance company. The Polar Ship Certificate is the most important document for the insurance company, however, the intended route and the availability of resources, such as ice breaker assistance, and availability of spare parts, etc., influence the risk the insurance company is willing to take.

6 Conclusions

This chapter concludes the research study by answering the research question below.

Are the polar training courses increasing the safety of persons onboard ships operating in polar waters, and are these courses sufficient?

The Polar Code has filled a gap regarding the safety in polar waters, both regarding ships, persons, and the environment. Setting a minimum standard regarding operations in polar waters increases the probability of survival. By implementing requirements for seafarers in polar waters, even though it is just the officers involved in navigation, the Code has set requirements regarding training and certification for those who sail in polar waters. Meaning that not everyone can sail in polar waters as done before, even though not all ships sailing in the areas need to comply with the Polar Code. The addition of the course gives the seafarers knowledge about the challenging waters and gives them the tools needed to understand and make better choices based on the knowledge acquired in the courses. During the few interviews conducted, all the participants agree that the Polar Code was an important code to implement for maritime safety. But the Code is goal-based, often providing functional requirements without specific details on how to achieve fulfilling the requirements, often the flag state must see that the requirements are met.

Safe operations in polar waters depend on experienced seafarers due to the complexity of navigation. The Polar Code has set minimum requirements for a lot of the challenges in polar water operations, which ensures a minimum standard of competence and safety. The Polar Code training course is made to comply with the requirements set in the relevant legal documents and seems like a good way to increase the minimum level of competence in polar waters for those in charge of navigation. The best way to ensure the safety of ships, the environment, and the people available is by increasing the knowledge of those involved with ship operations in polar waters. However, it is not only the seafarers on the ship sailing involved with decision making related to the ship; it is also the shipping company and/or charterer. Increasing the knowledge of those on land may be equally important to reduce the pressure the seafarers and especially the captain is under by the organization on land. The courses schedules compared in this thesis show that it is hard to comply with the recommended time usage on the model course.

A safety course dedicated to crewmembers regarding polar waters could be implemented to increase safety even further. This could increase the chance of survival because it has previously been seen that a steady leader is important in an emergency and is essential in polar waters due to the extended period it may take for rescue. Depending on ship size and number of persons onboard, the need for additional safety training for those who should lead is important to increase with the passenger number. It will increase the probability to survive the maximum time of rescue of 5 days, by giving the leaders in survival crafts the knowledge and tools to lead in polar waters with cold temperatures and harsh climate.

The existing requirements given in the legal framework of the Polar Code, and the STCW convention only requires additional polar water training for the officers on the bridge, excluding other crewmembers. In an emergency, all crew members will be involved with their pre-designated tasks regarding the emergency. On a ship carrying passengers, crewmembers in different positions may be assigned a leader position. Therefore, a well-trained and educated crew is important to ensure safety. It does not necessarily need to be the current polar training course for all crew members since it focuses on navigation in polar waters. Some type of polar survival course may be sufficient to increase the probability of survival. The officers who will sail the ship will need training in ice navigation to operate in icy waters, and the training will better prepare them to make safe choices and ensure a safe voyage. Aboa Mare stated that those with experience from ice navigation would learn much quicker than those who do not have experience, when attending their courses.

The challenges present in polar waters are challenges the seafarers or passengers may have little experience with unless they have experience from cold climate, meaning several people may need additional training and help regarding taking care of themselves in case of an emergency. For example, the layering of woolen clothes is common knowledge when living in the north is not something people without the cold climate experience will do unless told. Masters, chief officers, and officers in charge of navigational watch will learn about crew preparation. However, there is no way of controlling that the crew is ready to face the challenges of for example cold temperatures, icing, and wind chill. It is of great importance that the officers in charge of preparing the crew have knowledge and experience. However, there are only 2 hours on the recommended time usage of the model course specific to this theme. The crew will most likely need more preparation to understand the effects of working in low temperatures and on ice-covered surfaces. Therefore, the officers should use much time to prepare the crew regarding the challenges they may face, as they do not have experience with before working in a cold climate.

"Since the Polar Code is not a stand-alone regulation, it must be regarded in the context of the related IMO instruments, other instruments of national law and the applicable national regulations depending on the area of operation. The issue of a PSC relies on an assessment of the operational limits of the ship in ice, with reference to methodologies for assessing operational capabilities and limitations in ice and the Polar Operational Limit Assessment Risk Indexing System (POLARIS)" (Engtrø, 2021).

Insurance companies have to decide if they want to provide insurance for polar voyages; they will do case-by-case assessments based on the intended voyage. Since there is a lack of historical data regarding sailings in the Arctic, the assessment is hard to do. However, if the ship has a PSC, and the intended route has available ports, ice breaker assistance, and the crew is competent, insurers are more likely to grant insurance for polar voyages. Insurance is a great way for shipping companies to transfer the consequences of an accident to the insurance company.

As seen in chapter 2, several services and aids are provided to help the seafarers make safe polar voyages. Through the polar code courses, the officers will learn how to use the information and services available to make decisions regarding the voyage. For example, the officers will need to understand weather forecasts and ice charts to make decisions not to get stuck in ice or how to avoid ice. To understand this, they need to know where to get the latest charts and forecasts to understand this. In addition, the officers need to understand their Polar Water Operational Manual (PWOM), which is intended to support the decision-making process, and which includes plans on how to handle a worst-case scenario in the conditions that may be encountered.

In conclusion, there are several ways to increase the safety of those who sail in polar waters. The Polar Code has set minimum requirements regarding safety equipment and sets requirements regarding training. The technology and aids for the seafarers are evolving, there are different ways of limiting the stress of using the SAR resources in case of an accident; e.g. using the buddy system or requesting a fee per passenger to make resources more available. The Polar Code course is a start concerning the training needed to ensure safety; it sets a minimum competence level for the navigators on the ships operating in polar waters. Therefore, a course for a larger group regarding survival in cold environments and polar waters will be beneficial for increasing the probability of survival in the case of an accident.

Further work

Since the maritime operations in polar waters only seem to increase, there is a need for more research regarding crew and passenger safety. It could be interesting to investigate the problems regarding safety in polar waters and the Polar Code even further, finding out more ways to decrease the risks of fatal accidents in these areas.

As suggested in the conclusion, either a "Polar basic safety course" can be developed and introduced for all seafarers working on ships operating in polar waters to increase safety, or an additional theme regarding polar water survival can be added to the existing STCW basic safety training course. Based on the interviews, other research done, and personal experience, it would be interesting to contribute to the development of such course module.

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Appendix I - Questionnaire

Spørreskjema

Hei,
Jeg er master Student ved UiT og holder på med avsluttende masteroppgave som handler om kompetansenivået til de personene som er involvert med skipsfart i polare farvann. Formålet med dette intervjuet er å innhente informasjon og utarbeide et datagrunnlag om Polarkoden og Polarkodekursene som tilbys pr dags dato.

Takk for at du tar deg tid til å svare på spørsmålene mine. Alle svar vil bli behandlet anonymt, ingen navn vil bli gjengitt i oppgaven. Spørsmålene er bygd opp for at jeg som forfatter av oppgaven skal få vite litt om bakgrunnen din med Polarkoden før noen spørsmål om selve polarkodekurset du har deltatt på, hvis du har deltatt på kurset og din erfaring med det.

Om du ikke ønsker å svare skriftlig, ønsker jeg gjerne en samtale på skype/teams/tlf og eventuelt mulighet til å ta opp samtalen for å skrive referat etterpå, etter referatet er ferdig vil lydfilen slettes. Om du tar deg tid til å svare på spørsmålene skriftlig er min e-post adresse: mpe142@post.uit.no

Med vennlig hilsen
Martine M. Pedersen

1. Hva er dine tanker om polarkoden?
2. Har du erfaring fra Polare farvann? Hvis ja, Hvilken type erfaring?
3. Hva er din rolle i forbindelse med Polarkoden? (Instruktør/operativ erfaring/forsking, etc.) eller: Hvilken erfaring har du i forbindelse med Polarkoden? (Antall år)
4. Har du tatt eller holdt basic eller advanced polarkodekurs? Hvis ja, hvor tok du kurset og er det lenge siden du har tatt kurset?
5. Hva var/er din oppfatning av kurset/ kursene?
6. Føler du at tidsbruken er riktig på kurset du var på mtp på de forskjellige temaene? (Ice nomenclature, ice detection and ice characteristics, regulations and standards, vessel characteristics, maneuvering in ice, voyage planning, icebreaker assistance vessel performance in Polar waters, Crew preparation, working conditions & safety, environment)
7. Hvilke temaer på kurset syns du var bra og hvilke var mindre bra i forhold til din erfaring med polarkoden/farvannet?
8. Hva tenker du om tidsbruken på de forskjellige temaene? Hva kunne vært brukt mer/mindre tid på?
9. Sett i ettertid, hva kunne vært annerledes med gjennomføringen av kurset?
10. Tenker du at Polarkoden er med på å heve kompetansenivået i polare farvann?
11. Hvordan tenker du at man kan heve kompetansen for skipsfarten i polare farvann?

Spørsmål til kurssentre:

1. Føler du modellkurset dekker alt man som kursholder skal fokusere på for å heve kompetansenivået til kursdeltakerne?
2. Hvordan benytter dere tiden på temaer i forhold til modellkurset?
3. Ser dere noen problemer med å korte ned på kurset i forhold til modellkurset?

4. Hvordan bestemmer dere hvilke tema som er viktig og mindre viktig (f.eks angående de temaene som kortes ned på)?
5. Har dere noen temaer dere syns er viktig, men som ikke dekkes av modellkurset?
6. Synes du at det er tilstrekkelig tid brukt på simulator?
7. Tenker du at instruktørene er tilstrekkelig kvalifisert ihht. kravene gitt i Modellkurset?
   -Appropriate training in instructional techniques and training methods, and recommended that they are experienced in operating ships in polar waters;
   - Detailed knowledge of the requirements of preparation of a vessel operating in low air temperatures;
   - Up-to-date knowledge of ice classes and equipment requirements to navigate in ice;
   - Knowledge of crew preparation, working conditions and safety in polar conditions
   - Knowledge of pollution-prevention requirements)
8. Er det viktig for dere at instruktører har erfaring fra polare farvann?
9. Føler du som instruktør at kursdeltakerne er klar for å møte de utfordringene som finnes i Polare farvann etter endt kurs?
10. Bør det kreves at flere som er involvert i polar skipsfart tar polarkodekurs Basic og eller Advanced? (for eksempel se som skal føre en eventuell livbåt)

Appendix II - Table A-VI/2-1

Specification of the minimum standard of competence in survival craft and rescue boats, other than fast rescue boats (IMO, 2017b).

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	METHODS FOR DEMONSTRATING COMPETENCE	CRITERIA FOR EVALUATING COMPETENCE
Take charge of a survival craft or rescue boat during and after launch	Construction and outfit of survival craft and rescue boats and individual items of their equipment Particular characteristics and facilities of survival craft and rescue boats Various types of devices used for launching survival craft and rescue boats Methods of launching survival craft into a rough sea Methods of recovering survival craft Action to be taken after leaving the ship Methods of launching and recovering rescue boats in a rough sea	Assessment of evidence obtained from practical demonstration of ability to: .1 right an inverted life raft while wearing a life-jacket .2 interpret the markings on survival craft as to the number of persons they are intended to carry .3 give correct commands for launching and boarding survival craft, clearing the ship and handling and disembarking persons from survival craft .4 prepare and safely launch survival craft and clear the ship's side quickly .5 safely recover survival craft and rescue boats Using: inflatable life raft and open or enclosed lifeboat with inboard engine	Preparation, boarding and launching of survival craft are within equipment limitations and enable survival craft to clear the ship safely Initial actions on leaving the ship minimize threat to survival Recovery of survival craft and rescue boats is within equipment limitations
Operate a survival craft engine	Methods of starting and operating a survival craft engine and its accessories together with the use of the fire extinguisher provided	Assessment of evidence obtained from practical demonstration of ability to start and operate an inboard engine fitted in an open or enclosed lifeboat	Propulsion is available and maintained as required for maneuvering
COMPETENCE	**KNOWLEDGE, UNDERSTANDING AND PROFICIENCY**	**METHODS FOR DEMONSTRATING COMPETENCE**	**CRITERIA FOR EVALUATING COMPETENCE**
Manage survivors and survival craft after abandoning ship	Handling survival craft in rough weather Use of painter, sea anchor and all other equipment Apportionment of food and water in survival craft Action taken to maximize detectability and location of survival craft Method of helicopter rescue Effects of hypothermia and its prevention; use of protective covers and garments including	Assessment of evidence obtained from practical demonstration of ability to: .1 row and steer a boat and steer by compass .2 use individual items of equipment of survival craft .3 rig devices to aid location	Survival management is appropriate to prevailing circumstances and conditions

	immersion suits and thermal protective aids Use of rescue boats and motor lifeboats for marshalling life rafts and rescue of survivors and persons in the sea Beaching survival craft		
Use locating devices, including communication and signaling apparatus and pyrotechnics	Radio life-saving appliances carried in survival craft, including satellite EPIRBs and SARTs Pyrotechnic distress signals	Assessment of evidence obtained from practical demonstration of ability to: .1 use portable radio equipment for survival craft .2 use signaling equipment, including pyrotechnics	Use and choice of communication and signaling apparatus is appropriate to prevailing circumstances and conditions
COMPETENCE	**KNOWLEDGE, UNDERSTANDING AND PROFICIENCY**	**METHODS FOR DEMONSTRATING COMPETENCE**	**CRITERIA FOR EVALUATING COMPETENCE**
Apply first aid to survivors	Use of the first aid kit and resuscitation techniques Management of injured persons, including control of bleeding and shock	Assessment of evidence obtained from practical demonstration of ability to deal with injured persons both during and after abandonment using first aid kit and resuscitation techniques	Identification of the probable cause, nature and extent of injuries or condition is prompt and accurate Priority and sequence of treatment minimizes any threat to life

Appendix III – Table A-VI/1-1

Specification of minimum standard of competence in personal survival techniques (IMO, 2017b).

Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Survival at sea in the event of ship abandonment	Types of emergency situations which may occur, such as collision, fire, foundering Types of life-saving appliances normally carried on ships Equipment in survival craft Location of personal life-saving appliances Principles concerning survival, including: .1 value of training and drills .2 personal protective clothing and equipment .3 need to be ready for any emergency .4 actions to be taken when called to survival craft stations .5 actions to be taken when required to abandon the ship .6 actions to be taken when in the water .7 actions to be taken when abord a survival craft .8 main dangers to survivors	Assessment of evidence obtained from approved instruction or during attendance at an approved course or approved in-service experience and examination, including practical demonstration of competence to: .1 don a lifejacket .2 don and use an immersion suit .3safely jump from height into the water .4 right an inverted liferaft while wearing a lifejacket .5 swim while wearing a lifejacket .6 keep afloat without a lifejacket .7 board a survival craft from the ship and water while wearing a lifejacket .8 take initial actions on boarding survival craft to enhance chance of survival .9 stream a drogue or sea-anchor .10 operate survival craft equipment .11 operate location devices, including radio equipment	Action taken on identifying muster signals is appropriate to the indicated emergency and complies with established procedures The timing and sequence of individual actions are appropriate to the prevailing circumstance and conditions and minimize potential dangers and threats to survival Method of boarding survival craft is appropriate and avoids dangers to other survivors Initial actions after leaving the ship and procedures and actions in water minimize threats to survival